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THE JOURNAL
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NOTES FOR THE MONTH

Pig and Bacon Industry: Government Long-Term Policy

A statement outlining the Government's proposals for the re-organization and assistance of the bacon and bacon pig industry was made by Mr. Morrison in the House of Commons on March 10, in the following terms:—

" In the statement of policy which I made on July 29 last, in reply to a question by the right hon. Gentleman, the Leader of the Opposition, I indicated that the difficulties of the bacon industry appeared to be due in part to the high cost of pig feeding-stuffs and in part to high costs of bacon manufacture. I said that if the Government could be assured that there would be effective reorganization of the bacon factories, they would be willing to propose that some assistance should be accorded to the industry over a sufficient period to enable the contract system for the sale of pigs to curers to be re-established.

" The negotiations with the Pigs and Bacon Marketing Boards foreshadowed in that statement have resulted in agreement as to the nature and form of the changes in organization that are required.

" It is proposed to reconstitute the Bacon Development Board, to increase the number of independent members, and to give that Board wider powers of co-ordination and of policy control than it has had in the past.

" The Bacon Marketing Board are preparing a scheme of factory rationalization, having for its object a reduction of the number of curing units and of total curing capacity, and the introduction of higher and more uniform standards of efficiency in bacon production. The Government are assured that rationalization on these lines will proceed.

" The method of sale of pigs to curers on annual contract will be restored.

" Accordingly, the Government propose the following financial arrangements for a period of three years:—

" In the first year, pig producers will receive in respect of pigs of a prescribed standard produced in Great Britain and delivered to bacon factories in fulfilment of annual contracts a basic price of 12*s*. 6*d*. a score deadweight when the cost of a standard feeding-stuffs ration is 8*s*. 6*d*. per cwt. To enable this basic price to be paid, curers will be compensated from the Exchequer in the event of any fall in bacon prices below a notional price of 94*s*. 9*d*. per cwt. Pig producers for their part will be similarly compensated in the event of the cost of the feeding-stuffs ration exceeding 8*s*. 6*d*. cwt.

" In the second year, the basic pig price will be reduced by 1*d*. per score and the notional bacon price by 1*s*. per cwt.; in the third year, the price to be paid for pigs will be reduced by a further 2*d*. per score and the notional bacon price by a further 2*s*. per cwt.

" If, during the three-year period, the cost of the feeding-stuffs ration falls below 8*s*. 6*d*. per cwt., or bacon prices are above the notional figure, there will be a corresponding recoupment by the Exchequer.

" The number of pigs that may be assisted under these arrangements will be 2,100,000 in the first year, 2,400,000 in the second year, and 2,500,000 in the third.

" It will be a condition of assistance that the industry itself shall finance an approved programme of research, education and related services, with the primary object of reducing the costs of pig production.

" During the three-year period, the regulation of bacon supplies will be continued so as to maintain reasonable prices in the general interest, but the Government will not regard themselves as restricted to any given total.

" The cost of these proposals to the Exchequer will depend on certain unpredictable factors, including the course of prices of feeding-stuffs and the price of bacon, but on certain assumptions the cost might average approximately £1 million a year.

" Legislation will be introduced before Easter to give effect to these proposals as a whole. The Government commend them to Parliament as being calculated to assist the industry to reduce its costs of operation, attain a higher level of efficiency, and put itself generally on a self-supporting basis."

Agriculture Act, 1937. Part IV (Diseases of Animals)

The Minister of Agriculture and Fisheries has made an Order under Section 34 (3) of the Agriculture Act, 1937, directing that, save as otherwise expressly provided therein, Part IV of the Act shall come into operation on April 1, 1938. As and from that date the functions of veterinary inspectors in Great Britain under the Diseases of Animals Acts and any enactments relating to milk or to dairies will accordingly be discharged by veterinary inspectors appointed by the Minister of Agriculture and Fisheries.

Foot-and-Mouth Disease Research

The Minister of Agriculture and Fisheries has recently had under consideration the question of the future of research work into foot-and-mouth disease that is being conducted under the control of the Foot-and-Mouth Disease Research Committee.

The problem under investigation is a complex one, and its scope has become wider than was envisaged when the work was first started 14 years ago. There is increasing evidence of the necessity for pursuing the intensive study of this particular member of a group of diseases affecting human beings, animals and plants in close relationship with investigations into virus diseases generally, and of enlisting the experience of workers in other fields of virus research in the elucidation of the problems connected with foot-and-mouth disease.

In the circumstances, the Minister, after consultation with the Development Commissioners, has come to the conclusion that it would be an advantage if the Agricultural Research Council and the Medical Research Council were more actively and directly associated with the work of the Committee than at present, and, with this object in view, has decided to broaden the basis of the Committee by appointing additional members, in consultation with the two Councils. He has accordingly appointed the following to serve on the Committee:—

Professor S. B Bedson, M.D., M.Sc, F R S (of the London Hospital).
Professor T. Dalling, M.A., M R.C.V S. (Director of the Institute of Animal Pathology, Cambridge).
Major G. W. Dunkin, M.R.C.V.S., D.V.H. (Director, Agricultural Research Council Field Station).
G M Findlay, Esq, C B.E., M.D, D.Sc (of the Wellcome Bureau of Scientific Research).
Professor H. B. Maitland, M.B., M.Sc. (of the University of Manchester).

Professor F. C. Minett, M.B.E., D.Sc., M.R.C.V.S. (Director, Research Institute in Animal Pathology, Royal Veterinary College).

J. Henderson Smith, Esq., M.B., Ch.B., B.A. (of the Rothamsted Experimental Station).

The existing members of the Committee are as follows:—

Sir Joseph Arkwright, M.D., B.Ch., F.R.C.P., M.R.C.S., F.R.S. (Lister Institute of Preventive Medicine), Chairman.

Dr. W. Horner Andrews, D.Sc., M R.C V.S. (Director of Veterinary Laboratory, Ministry of Agriculture and Fisheries).

Professor W. Bulloch, M.D., F.R.S. (Professor of Bacteriology, University of London).

Professor J. Basil Buxton, M.A., F.R.C.V.S., D.V.H. (Principal of the Royal Veterinary College).

Dr. J. Russell Greig, M.R.C.V.S. (Director of the Moredun Institute, Gilmerton, Midlothian).

Sir John Kelland, M.R.C.V.S. (Chief Veterinary Officer, Ministry of Agriculture and Fisheries).

Sir Patrick Laidlaw, B.Ch., F.R.C.P., F.R.S. (Director of the Department of Experimental Pathology, National Institute for Medical Research).

Dr. Charles Todd, O.B.E., M.A , F.R S (National Institute for Medical Research).

V. E. Wilkins, Esq , O.B.E. (Ministry of Agriculture and Fisheries).

Produce of Certain Minor Crops in England and Wales, 1937

Estimates of the total produce and yield per acre of the principal corn, hay and root crops in England and Wales in 1937 were published in the *Agricultural Market Report* on December 24 last. Corresponding estimates, with comparative figures for 1936, and the average yield per acre of the 10 years 1927-1936, are given below in respect of rye, onions, carrots and mustard for seed.

Crop	Estimated Total Produce		Acreage				Estimated Yield per Acre		
	1937	1936	Total Acreage 1937	Acreage Harvested Ripe or as Grain 1937	Total Acreage 1936	Acreage Harvested Ripe or as Grain 1936	1937	1936	Avge. of the 10 Yrs. 1927 to 1936
	000's Tons	000's Tons	Acres	Acres	Acres	Acres	Cwt	Cwt.	Cwt.
Rye ..	7·0	8·6	16,048	11,681	19,188	14,084	12·0	12·1	13·3
							Tons	Tons	Tons
Onions	5·4	5·3	1,656	812	1,592	860	6·7	6·2	6·0
Carrots	141·9	237·6	13,924		16,608		10·2	14·3	11·4
							Cwt.	Cwt.	Cwt.
Mustard for seed	9·5	13·9	24,154		31,920		7·9	8·7	8·5

Rye. The acreage under rye in 1937 decreased by 3,140 acres to 16,048 acres. Of this acreage 11,681 acres were harvested as grain, a reduction of 2,403 acres compared with 1936. The estimated yield per acre in 1937 showed a decrease of 0.1 cwt. from the yield in 1936, and was 1.3 cwt. per acre below the average of the ten years 1927-1936. The reduction in acreage, coupled with the slightly diminished yield, resulted in a decrease in the total production of rye from 8,600 tons in 1936 to 7,000 tons in 1937 or over 18 per cent.

Onions. Of a total acreage of 1,656 acres in 1937, 812 acres were harvested ripe. The position thus shows little change from 1936 when 860 acres were harvested ripe out of a total acreage of 1,592 acres. Although the area harvested ripe in 1937 was 48 acres less than in 1936, the yield increased by 0.5 tons to 6.7 tons per acre in 1937, or 0.7 tons per acre more than the average yield for the previous 10 years, and the total production of onions increased by 100 tons (2 per cent.) to 5,400 tons.

Carrots. The acreage under carrots in 1937 was less by 2,684 acres than that in 1936, when an area of 16,608 acres was recorded. The yield also showed a considerable reduction, being 10.2 tons per acre in 1937 as against 14.3 tons in 1936, and was 1.2 tons per acre below the average of the ten years 1927-1936. The decline in the total production from 237,600 tons in 1936 to 141,900 tons in 1937 amounted to 40 per cent.

Mustard for Seed. The acreage under this crop, which, in 1936, was 31,920 acres, decreased by 7,766 acres to 24,154 acres in 1937. The yield at 7.9 cwt. per acre was 0.8 cwt. less than in 1936, and 0.6 cwt. less than the average of the ten years 1927-1936. The total production decreased by 32 per cent. from 13,900 tons in 1936 to 9,500 tons in 1937.

Destruction of Docks in Seed Clover with Sodium Chlorate

The following note has been communicated by Lieut.-Col. E. Barnardiston:—

In March, 1935, about 8 acres of winter wheat were sown with a registered strain of Montgomery Late-Flowering Red Clover, at the rate of 10 lb. per acre. The lower part of the same field was sown with barley and a pedigree strain of perennial ryegrass, with the object of harvesting grass seed in 1936 and 1937.

The clover was sown in the upper part of the field with the

object of taking two hay crops in 1936 and a seed crop in 1937, so that the whole field could be ploughed up again in the autumn of 1937. In 1937 the clover was grazed until the first week in June, by about 100 ewes and 40 lambs.

The field has long been badly infested with docks, and, the season and conditions apparently being favourable, they appeared in great quantity in the clover. The problem was how to deal with them: they could not be left to seed with the clover, digging them up was impracticable; spudding would not have had the desired result, and broadcasting a weed-killer would have destroyed the clover.

It was decided, therefore, to try sodium chlorate applied by hand, and a pinch of the chemical was placed in the centre of each dock so as to avoid as far as possible any damage to the clover. It took a man about one week to apply the chlorate, and 1 cwt. of the material was used. The total cost was about £3, or 7*s*. 6*d*. per acre.

The result of the treatment was entirely satisfactory. Every dock so treated appeared to be completely destroyed, including the rootstocks, and the damage to the clover was negligible. The application was made whilst the sheep were grazing, and as the dock leaves withered the sheep ate them clean up with no ill effects.

The clover was a fine sight when in flower and the accompanying photographs, taken by Mr. Gwilym Evans of the Welsh Plant Breeding Station, Aberystwyth, give a good idea of its appearance. One photograph shows the perennial rye-grass in stooks and the clover beyond. The yield of clover was over 2¾ cwt. per acre of best seed, with a purity of 98.6 per cent. There was no "injurious weed seeds," only 0.1 per cent. of self-heal, 0.3 per cent. of grasses (catstail, crested dog's tail, meadow grasses and bents), and 1.0 per cent. of damaged seeds, dirt and chaff. The germination was 86 per cent. and hard seeds amounted to 9 per cent.

It may be added that no further growth of any kind appeared when the chlorate had been applied, although seedling docks came up after the clover had been cut, but away from the treated parts. The 8 acres were subsequently ploughed and sown with oats. On February 2, 1938, only two or three old dock roots could be found on the land; these had probably missed treatment. If the treatment had not been given quantities of dock roots would have been turned up by the plough and exposed by the harrows.

FIG. 1 Field of Montgomery Red Clover

FIG. 2 Perennial Rye-grass in Stooks with Field of Montgomery Red Clover beyond on right

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Census of Production of Milk and Milk Products on Farms in England and Wales, 1935-36

Census inquiries relating to the volume of production of those agricultural products which are not estimated annually have been carried out since the War, in 1925 and again in 1930-31. Instead of making a further comprehensive inquiry in 1935, such inquiries are now being spread over a period of 5 years. The inquiry relating to milk and milk products now under review was made in June, 1936, covering the year ended May 31, 1936, and in essence was on similar lines to those conducted in 1925 and 1930-31. An attempt was made, however, to determine more exactly the amounts of milk utilized for the various purposes and in particular the amount of milk fed to live stock.

In spite of the extra information asked for and the more elaborate form of the return, it is gratifying to note that returns relating to 45 per cent. of the dairy herd were capable of being used in tabulation as against 42 per cent. in the census of 1930-31. Improved methods of utilizing the returns received in the latest census have probably secured more accurate results than in 1930-31.

The changes revealed by the figures for 1925, 1930-31 and 1935-36 have in fact all been in the directions suggested by general expectation; nor is the magnitude of the differences between the results of the earlier inquiries and those of 1935-36 such as to throw serious doubt upon the earlier figures. Comparison of the results, however, suggests that any error in the estimate of milk production in 1930-31 was in exaggerating rather than in minimizing the average yield per cow, and in comparing the results of the two inquiries of 1930-31 and 1935-36, this probability should be borne in mind.

The main feature revealed by a comparison of the 1930-31 results with those of the earlier census of 1925 was a substantial increase in milk production resulting from a relatively small increase in the dairy herd, so that the improvement in total production was due almost entirely to the rise in the average lactation yield per cow from 482 gal. in 1925 to 539 gal. in 1930-31. Comparison of the 1935-36 results with those of 1930-31 reveals, however, that the increase in production of milk (exclusive of that fed to live stock) from 1,263 million gal. in 1930-31 to 1,316 million gal. in 1935-36, or just over 4 per cent., was obtained from a dairy herd that had increased

in numbers by about 12 per cent. The fact that production fell short of the expectation based on cow population was due, therefore, to the reduction in the average lactation yield per cow from 539 gal. in 1930-31 to 502 gal. in 1935-36.

A number of causes can be assigned to this marked fall in average yield between the two years, but it is probable that weather conditions were chiefly responsible. The state of the weather, condition of the pastures and amount of the hay crop were definitely more favourable to milk production in the census year June, 1930, to May, 1931, than in the corresponding year 1935-36. When comparison is made of the results in the various agricultural divisions, the greatest falls in yield are found to have occurred in the Eastern areas while in the Western areas comparatively small declines were recorded.

The principal results of the inquiries in 1935-36 compared, as far as possible, with those of 1930-31, are set out in the table below:—

Item	Unit	1930–31	1935–36
Total production of milk (excluding milk fed to live stock)	Million gallons	1,263	1,316
Milk sold	,,	949	1,098†
*Milk consumed in farm households	,,	64	58
Butter made	Thousand cwt.	651	393
,, sold	,,	529	293
Cheese made	,,	547	170
,, sold	,,	535	156
Cream made	Thousand gallons	Unknown	1,222
,, sold	,,	1,339	992

* Includes in 1935–36 sales and gifts to employees and in 1930–31 it includes cream (in terms of milk) consumed in farm households.

† Net sales after deducting purchased milk.

The figures given above indicate that although the production in 1935-36 increased by only 53 million gal., the sale of milk off farms rose by 149 million gal. The difference of 96 million gal. can be accounted for largely by the milk released from farm manufacture. As will be seen from the above table, the amount of butter manufactured on farms declined by nearly 40 per cent. since 1930-31 and cheese by nearly 69 per cent. Cream production and the amount of milk used in farm households may also have suffered some reduction.

It is not possible to say to what extent, if any, there was a change in the amount of whole milk fed to live stock as between 1930-31 and 1935-36, since no inquiry on this point was made in the former year. The result of the inquiry in 1935-36, however, shows that 149 million gal. were so fed, thus giving a total output of 1,465 million gal. from the dairy herd. No comparable figures are available for 1925, but it may be noted that it was estimated from external evidence that 10 per cent. of the total production was fed to live stock about that period.*

The utilization of the supply of milk, exclusive of that fed to live stock, is shown in the following table where all items are expressed in terms of milk. It should be noted that in 1930-31 the equivalents of the butter, cheese and cream sold are calculated on the formulae shown at the foot of the table, whereas in 1935-36 the amounts of milk are those stated by the farmer to have been used for the purpose.

Manner of Disposal	Million Gallons		Percentage of Total	
	1930–31	1935–36	1930–31	1935–36
Sales as liquid milk ..	949	1,098	75	83½
†Milk Equivalent of:—				
Butter sold	140	92	11	7
Cheese „	60	17½	5	1½
Cream „	16½	14	1	1
Farm consumption (milk, butter, cheese and cream)	97½	94½	8	7
Total production (excluding milk fed to live stock) ..	1,263	1,316	100	100

† 1930–31 equivalents were 264·1 gallons of milk to 1 cwt. butter 112·2 gallons to 1 cwt. cheese, and 12·3 gallons to 1 gallon cream.

Fuller details relating to the 1935-36 census of milk and milk products will be published in Part II of the Ministry's Agricultural Statistics, 1936.

Progress of the Land Fertility Scheme

The number of applications for contribution under the Land Fertility Scheme received from occupiers of agricultural land in the United Kingdom now exceeds 117,000. The quantities

* Report on the Agricultural Output of England and Wales, 1925.—Cmd. 2815, p. 61.

of lime and basic slag in respect of which these applications have been made are approximately 710,000 tons of lime and 288,000 tons of basic slag.

The Improvement of Grass Land

Once again farmers are reminded that now is the appropriate time for them to consider the advantages of improving their grass land, because they can obtain lime at one-half and basic slag at three-quarters of the cost delivered on the farm. Grass land improvement means better grass, more grass and a longer grazing season; it means more stock, better and healthier stock, and smaller bills for feeding stuffs.

No branch of agricultural research has made such progress in recent years as that dealing with the improvement and management of grass land. Further, the findings of research are now ripe for adoption by farmers, who are realizing more and more that grass land, properly managed, may in most areas be greatly improved in production value, with an economic return. Improved leafy strains of grasses are now becoming increasingly available, and the "management" methods that aim at securing the greatest crop at its highest level of food value, are now better understood.

In view of this increased attention now being devoted to grass land, a new edition of the Ministry's Bulletin No. 3, "*The Improvement of Grass Land* *" prepared by Professor J. A. Hanley, A.R.C.S., Ph.D., has just been issued. In addition to dealing with the findings of research, considerable attention is devoted in the Bulletin to the relative values of the methods of conserving grass—hay-making, ensilage and the more recently introduced grass drying. The various types of grass land, and their treatment by drainage, cultivation and manuring receive due attention, and the Bulletin concludes with notes on the relative and special values of the principal grasses and clovers.

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* Bulletin No 3. Price 1*s.* 6*d.* (post free 1*s.* 8*d.*) from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2

DAMAGE TO AGRICULTURAL LAND RESULTING FROM FLOODING WITH SEA WATER

H. T. CRANFIELD,
Advisory Chemist, Midland Agricultural College

The flooding of large areas of agricultural land by sea water is a problem with which British farmers are confronted only on comparatively rare occasions. The recent breaks in the sea wall surrounding parts of the Norfolk coast are the third major inundation by the sea during the past 50 years, the other two being the Essex floods in November, 1897, and the Humber (Lincolnshire and Yorkshire) floods in December, 1921. The conditions associated with these three inundations are very similar, and therefore any observations made and information obtained in relation to the earlier floodings should prove of interest and service to those who are directly concerned with the recent disaster in Norfolk.

Much of the land around the coasts of Lincolnshire, Norfolk and Essex consists of heavy boulder clay, and soil of this type presents a much more formidable problem than one would meet with on lighter and more sandy soils. Flooding with sea water affects the texture and therefore the fertility of the soil, and the time that must elapse before normal conditions are restored, and the treatment necessary, depend primarily on the nature of the land involved.

Essex, 1897. Regarding the 1897 floods in Essex, an investigation was undertaken by Dymond and Hughes, who state in their report[1]* that the area affected amounted to some 30,000 acres, and that the sea water remained on the land for periods ranging from a few hours to several weeks. The effect on the grass land did not at first appear to be serious, but later, when growth should have started, the more delicate grasses died off, and in only one instance was the hay crop worth harvesting. As to arable land, the report states that peas and tares were killed, whilst wheat died off in a short time where the land had been flooded for several days. In an endeavour to ascertain the actual cause of crop failure the investigators carried out experiments to test the presumed poisonous effect of common salt on various agricultural plants. They found that many plants were able to grow in the presence of a considerable percentage of salt when it was diffused through the soil, quantities as high as 0.25 per cent. in the surface soil (this was the average salt content of the Essex land immediately the flood water had subsided) being

* For references, see p. 15.

used. They came to the conclusion, however, that the vital factor was the action of the salt on the physical condition of the soil. Observations showed that the clay land had become "gelatinous" and impervious to rainwater; also that in dry weather it was apparent that the land had become very hard and "cindery." Incidentally it was noticed that earthworms had disappeared, many dead ones lying on the surface of the soil.

The rate of percolation of water through the soil was only half as rapid as with adjacent non-flooded land of similar texture. Chemical tests revealed that the percentage of lime and other bases in the soil had been reduced by the action of the sea water, and the investigators suggested that applications of lime were desirable to assist in the re-granulation of the clay. In this report, the necessity for the elimination of the excess salt was also stressed, and it was pointed out that this could be accomplished only by taking full advantage of the rainfall by encouraging rapid and efficient drainage. Tests of the salt content of the soil were made at intervals, and it was found that in 18 months this constituent had been reduced to one-quarter of that present immediately after the flooding. The results of these tests are given in the following table:—

			Average percentage Common Salt (NaCl)
1898.	Land not flooded	(surface soil)	0·011
	Land flooded	(first inch)	0·159
	,, ,,	(surface soil)	0·255
	,, ,,	(subsoil)	0·425
1899.	Land previously flooded	(first inch)	0·066
	,, ,, ,,	(surface soil)	0·057
	,, ,, ,,	(subsoil)	0·112

The after-treatment of the flooded land was given very careful consideration by the Essex investigators. They recommended that ploughing should not be undertaken until the greater portion of the salt had been washed out of the surface soil but that in dry weather light harrowing of the "capped" surface was advantageous in that it assisted in the aeration of the soil and in facilitating the washing out of the salt by rain. The working in of long dung and similar material whenever possible was also advocated. After a material reduction in the salt content of the soil had been effected, rape, cabbages and mangolds could be grown at first, followed by oats in preference to wheat.

The Humber Area, 1921. The Humber flood of 1921 covered several thousands of acres, and was particularly serious on the Lincolnshire side of the river, where the bulk of the land affected consists of heavy clay. A considerable proportion of the land was under arable cultivation at the time of the disaster. Many fields were ploughed out immediately the land would carry horses, and an endeavour made to grow spring corn, before the writer in conjunction with the Agricultural Education Officer for Lindsey (Mr. J. C. Leslie) was called in for consultation and advice. This treatment materially lengthened the period of recovery. When inspected in the spring of 1922, the land that had been ploughed was in a deplorable condition, the cultivations having accentuated the de-flocculation of the clay. However, much of the grass land recovered to some extent in 2 or 3 years, but as late as 1928—seven years after the flooding—many fields, formerly under arable crops, were still in a semi-derelict condition, although some improvement in soil conditions was noticeable. The history of one field on which frequent observations were made and experiments laid down may be of interest here.

This field, which had a good reputation as first-class land, was carrying winter wheat at the time of the flooding. Although the water remained on this field for a few days only, the plant was killed. The farmer ploughed this field as soon as practicable and drilled spring wheat. This germinated but failed to develop. In early April this field presented a forlorn appearance; after every shower, pools of water remained on the soil until evaporation effected their removal. It was obvious that drainage had ceased to function. Samples of soil gave the following results on analysis:—

	Percentage of Common Salt (NaCl)
Flooded area (top soil)	0·14
,, ,, (subsoil)	0·47
Unflooded area in corner of field (top soil)	0·009

In 1931 (10 years later), the field had practically recovered from the effect of the flooding, and samples of soil revealed:—

	Percentage of Common Salt (NaCl)
Top soil	0·001
Subsoil	0·002

This field was by no means the worst to be found in the

area affected, and it is therefore significant that nearly 10 years were necessary before recovery was complete.

Burnt lime (1-3 tons per acre) and gypsum (1-3 tons per acre) were applied to plots laid down in this field in 1922. Grass and clover seeds were sown over the plot area, which at this time was assuming gradually a mantle of weeds and coarse grasses. At intervals during the next few years, tests of the soil were made, and there were indications that both lime and gypsum were assisting to some extent the re-flocculation of the clay. However, for several years there appeared to be little improvement in the drainage and in the development of the better grasses. Wild white clover gradually appeared in places, particularly on the small patches of higher ground, whilst it was observed that certain weeds and grasses became deeper rooted each succeeding year. Earthworms, too, reappeared after some time.

In 1927, basic slag was applied to a portion of this field and a renovating mixture containing wild white clover was sown. This treatment met with some success, and a year later the field was producing a fair herbage in places and carrying stock.

In 1925, the Ministry of Agriculture requested the Rothamsted Experimental Station to make an investigation into the chemical and physical problems associated with the sea flooding of this land, and the results of this work were published by Page and Williams.[2] Besides giving results of many tests made on samples of soil from this area, this report discusses the various scientific problems involved in the action of salt water on the soil, and refers also to the work that has been carried out over a period of many years in Holland by chemists who have had great experience in the reclamation of sea-flooded land—both virgin foreshore and land previously cultivated.

The following summary gives a brief description of the chemical and physical effect of sea-water flooding on land and the best treatment to follow. It is hoped that this information may be of value particularly to the farmers in Norfolk who have this problem to face.

When salt water comes into contact with soil, a rapid change takes place in the composition of the clay fraction of the soil, calcium (lime) which is normally held by the clay particles being turned out by sodium (soda) which is a constituent of common salt. This reaction within the clay particles

results in the de-flocculation or de-granulation of the clay, with the result that the soil is rendered almost impervious to water. On land that has a low percentage of clay and a high percentage of sand this effect is not serious, and, since drainage is not materially affected, the salt is speedily washed out of the soil and the land recovers, assuming, of course, that the water table is well below the surface. Clay land, however, is profoundly affected by this chemical reaction and remains in this state until conditions favour the reversal of this interchange of lime and soda. Where clay soils are well supplied with lime compounds the process of recovery will commence as soon as drainage starts. Applications of lime or gypsum may be given to accelerate this action. It should be realized, also, that the digging of channels at frequent intervals across each field will assist in the removal of the drainage water and so assist in recovery of the soil.

Until the salt content of the soil has been reduced to the region of 0.01 per cent., good tilth cannot be re-established, and ploughing or deep cultivation of the soil must be avoided for some time, only light harrowing being practised to break up the surface crust. When the salt content has been reduced to a low level as shown by chemical tests, the land may be ploughed and cruciferous crops—rape, kale or mustard—sown as the first crop. These can be followed by mangolds or sugar-beet, or if corn is desired, oats or barley would be suitable. Recovery may be slow, depending on the period of flooding, the heaviness of the soil, and the subsequent treatment to accelerate drainage—including where necessary the lowering of the water level in the surrounding dykes.

[1] T. S Dymond. Report upon the Damage on Agricultural Land caused by the Salt-Water Flood of November 29th, 1897, with Suggestions for future Cultivation, County Technical Laboratories, Chelmsford, February, 1898.

T S. Dymond and F. Hughes: Report on the Injury to Agricultural Land on the Coast of Essex by the Inundation of Sea Water on November 29th, 1897, County Technical Laboratories, Chelmsford, September, 1899.

(Both the above are pamphlets issued by the Essex Technical Instruction Committee of that time)

[2] H. J. Page and W. Williams: The Effect of Flooding with Sea Water on the Fertility of the Soil, *Jour. Agric. Sci.*, Vol. XVI, 1926, p. 551.

FRUIT TREE SPRAYING IN 1937

J. TURNBULL,
Ministry of Agriculture and Fisheries

Double nozzles giving the type of spray recommended in this JOURNAL (Aug., 1934, pp. 433-435) are being widely used, and typical costs were given in this JOURNAL for March, 1937, pp. 1145-1157. Triple and quadruple nozzles giving the same type of spray have been available, but have not been much used. During the past season, an attempt has been made to ascertain the conditions for which they are suitable. For various reasons it has not been found possible to prepare a statement of the costs for publication, but some useful information has been obtained.

Nozzles, etc., Used. Thanks are due to fruit-growers who have allowed nozzles to be tried on their farms, and most of whom continued to use them throughout the season; also to Messrs. Weeks and Son, Maidstone, who made and lent triple and quadruple nozzles, a 4-ft. wooden-handled lance and a pressure gauge for use at the lance. Owing to a misunderstanding the first 4-nozzle heads were made with nozzle centres 4 in. apart, instead of the recommended 3⅝ in. The difference in performance was most striking. The spray from the nozzles with the wider spacing failed to carry as far by 6 or 8 ft., resulting in underspraying of the tops of tall trees and overspraying of the lower branches. The nozzles spaced 3⅝ in. from centre to centre and with the sprays parallel to each other, gave the correct type of spray with ample carry when the pressure was adequate, and resulted in good work, both in the tops and lower branches.

Central Plant. The use of 4-nozzle lances appeared most likely to be successful on the largest trees, and the first trial was carried out at the beginning of the lime-sulphur season on the large Bramleys on the farm of Mr. A. J. Wooldridge, described in this JOURNAL for March, 1937, p. 1149. It was found that a man cannot comfortably use the 4-nozzle head on a lance exceeding 4 ft. in length and the head must be straight, as even a slight bend creates too much back pressure. The pressure *at the nozzle* found necessary to reach

the tops of these trees was not less than 450 lb. per sq. in., and this was used. Special taps that operate instantaneously were also used.

In order to ascertain whether a man could use so large an output without wasting wash, two half-acre plots, as nearly comparable as possible, each consisting of 15 very large Bramleys, were selected. One plot was sprayed with a 6 ft. lance, double nozzle (5/64th in. discs), giving an output of about 5 gal. per min. This took 48 min., and 217 gal. of wash were used. The other plot was sprayed by the same man with a 4 ft. lance, 4-nozzle head (4/64th in. discs), giving an output of about 6 gal. per min. This took 42 min., and 214 gal. of wash were used. The tops of the trees were more easily covered. This showed conclusively that the man could deal with the larger output. Similar lances were used on this farm throughout the season. Either 2 or 3 were in use at the same time and the pressure was raised to 500 lb. per sq. in. at the nozzle (in this instance requiring 600 lb. at the pump). Each man sprayed 5 acres in each complete spraying day, generally with one hour overtime. This acreage was also sprayed when working in the Lord Derby, etc., at 24 ft. apart, as well as in the Bramleys at 36 ft. apart. This compares with an average of 2.6 acres per 9-hr. day in the previous season. The quantity of wash used averaged 375 gal. per acre, which is a low figure for trees of this size. The men found the work less tiring than when covering only half the quantity of wood in the previous season. It was found that one 4-nozzle lance could be worked off a ¾-in. pipe. Two such lances could not be adequately supplied through a 1-in. pipe, but required a 1¼-in. pipe, or two ¾-in. pipes working off one 1¼-in.

At a trial on another farm on large trees 24 ft. apart, double, triple and quadruple nozzles (all fitted with 4/64th in. discs) were tried on a few trees each at a pressure of 425 lb. per sq. in. at the nozzle. The times taken were in inverse proportion to the output of the nozzles, so that the quantities of wash must have been approximately the same in each instance. The man who used them preferred the triple nozzle head, saying that he could see better what he was doing. Elsewhere, with a pressure of 350 lb. at the nozzle, the spray from the 4-nozzle head did not reach the tops of the trees well enough in a strongish wind. On another farm the pressure at the nozzle was only 250 lb. per sq. in., and the tops of

tall trees could not be reached with this spray, even in fairly still weather. Larger discs were tried but the pump capacity was insufficient to supply them. These experiences show that extremely high pressure is needed when using this type of spray on really tall trees.

Mobile Plants. 3- and 4-nozzle lances were used on two outfits of 12 h.p., one of 4½ h.p. and one of 3 h.p., drawn up the tree rows by tractor. At one farm two 2-ft. lances with 4-nozzle heads (fitted with 5/64th in. discs, giving an output of 10 gal. per min. to each lance at a pressure of 600 lb. per sq. in. at the pump) were used on a 12 h.p. outfit. The men walked behind, as the trees were too close to allow them to ride. This worked well on a 15- or 18-ft. plant, but the output was too small for a 30-ft. plant, and it was necessary to keep stopping the tractor. It might have been possible to work "non-stop," if the tractor could have been geared down to about 1 m.p.h. On the other hand, it was noted that it took 18 min. to empty a 200-gal. tank, which is about the same time as was taken elsewhere when each man had an output of only 6 gal. per min. This may indicate that a man cannot use effectively more than 6 gal. per min. when walking, though experience elsewhere has indicated that he can use a much larger spray when riding. Contrary to expectation, no wash was wasted with the larger spray, probably owing to the instantaneous cut-offs being used whenever the trees were sprayed faster than the man could walk. The total daily output was 2,400 gal., and the smallness of this amount was due to the time wasted in re-filling.

Mr. Mursell, of Mursell and Wyldbore, Wisborough Green, Sussex, paid special attention to quick re-filling. The spray tank on his 12 h.p. 20-gal. per min. mobile outfit will hold 500 gal., but the quantity put in varies from 250 to 500 gal. according to the state of the land. It is re-filled at the headland by a tractor-drawn water cart fitted with a 200-gal.-per-min. delivery pump, and the stopping time for a re-fill is only 6 min. The farm consists entirely of young trees, and two 2-ft. lances with 4-nozzle heads (fitted with 4/64th in. discs, giving an output of 6 gal. per min. each at a pump pressure of 600 lb. per sq. in.) were used, the outfit being drawn up and down the rows "non-stop." The men rode on the outfit and the tractor speed was varied, so that the trees got enough spray and not too much. It took 30 min. to use 300 gal.,

and this did 2 acres of 5- to 6-yr. old trees (about 8ft. in diameter), or a larger acreage of smaller ones with tar oil. The team consisted of 4 men and 2 tractors, and the daily output averaged 3,600 gal. in 9 hr., or 4,500 gal. in 11 hr., which covered a very large acreage of small trees. It will be seen that the extra man and tractor increased the output 50 per cent. over the method of working described in the previous paragraph.

Single lances with 3 or 4 nozzles have been used on smaller outfits. At one farm a 4-nozzle lance (4/64th in. discs, 350 lb. pressure) was used on a 4½-h.p. outfit drawn up and down rows of bush trees 12 ft. apart by tractor. The sprayman could not ride on top, owing to overhanging branches, but sat on a seat fixed at the back of the machine. If there was much wind, however, he got too wet when spraying into it, and then had to walk. It took 25 min. to empty the 100-gal. tank and 20 min. to fill it. The average was 12 tanks per day, 1,200 gal., and this did 5 or 6 acres.

Elsewhere a 2-ft. lance with 3-nozzle head (4½/64th in. discs, 400 lb. pressure) was used on a 3-h.p. outfit. The man sat on top at the back, while the outfit was drawn up and down the rows (15 ft. apart) by tractor. It took 17 min. to use 80 gal. on about ½ acre of a fairly full plant. Another man with horse and water cart refilled the tank in 6 min. The average was 20 tanks, 1,600 gal. per day on 8 to 10 acres. Here again the extra man and horse increased the work done in a day very considerably.

There is always a great temptation to use a mobile outfit "non-stop" when a tractor is available, because the work is done very easily and quickly, especially when the spraymen can ride. If the pump and nozzle capacity are large enough to deliver sufficient spray to give a good cover in the time that the speed of the tractor allows, the work done is very satisfactory. If, however, the pump and nozzle capacity are inadequate, the work is done very badly and this should not be allowed. Either the output must be increased, or the speed of the tractor reduced, until a balance has been obtained. Failing one or other of these alterations, "non-stop" spraying must be abandoned and the tractor must keep stopping and starting, so as to allow sufficient time for spraying.

Another difficulty in mobile spraying is the large proportion of the day during which spraying must stop while the tank is being re-filled. With quite good arrangements it takes

20 min. to go to a filling centre, fill up and return. On one farm where water had been laid on to a number of points at each of which a tank was filling itself while spraying was in progress, the delay was only 10 min., and this appears to be as short a time as possible, without using extra labour. A large tank can be filled as quickly as a small one, by using a low pressure pump of suitable capacity. In two instances quoted above, an extra man with water cart and tractor or horse (according to the size of the tank) has cut down the waste time to 6 min. One fruitgrower uses duplicate trailer tanks (instead of having one as an integral part of the outfit) with an extra man and horse or tractor to bring a full tank to the outfit and take away the empty one. He states that the delay involved is only 2 min. and this method appears very promising.

Pump Capacity. One of the commonest causes of bad work is overloading the pump. An example may be given. In an attempt to arrive at the capacity of the 3-h.p. outfit mentioned above, progressively larger discs were fitted to a double nozzle, and the time taken to spray a group of 10 trees was taken. All went well when any size discs up to 7/64th in. were fitted and the pressure was 300 lb. per sq. in. When 8/64th in. discs were fitted, however, the pressure fell to 250, a nasty woolly spray was given, lacking in drive, and the work took 50 per cent. longer, showing that much more wash was used, and the work was also done very badly. Few fruitgrowers make the mistake of fitting too large discs, but a great many achieve the same bad result by fitting too many nozzles for the capacity of the pump. This appears to explain why so many think that if they allow the men to have a large spray, they will use more wash. It is not that the individual having a large spray wastes wash, but that when the pump capacity is inadequate the type of spray is a bad one. For example, a pump actually delivering 15 gal. per min. can supply 5 men at 3 gal. per min. each, or 3 men at 5 gal. per min. each. It cannot possibly supply 5 men at 5 gal. per min. each, and, if this is attempted, a great waste of wash may result.

English pump manufacturers are much to blame in quoting for their pumps an output that is worked out on paper and *bears no relation to the genuine output at the nozzles.* It has frequently been found that the real output is no more

than two-thirds of that stated by the makers. That is a bad state of affairs that ought to be remedied. Meanwhile, fruit-growers can tell by watching the spray. If there is any variation whatsoever in one spray when another is turned on and off, then something is wrong with the arrangements somewhere. Either the pump cannot supply the number of nozzles in use, or the pipes are not large enough to carry the quantity passing without losing a substantial amount of pressure. The latter point has already been mentioned. Good spraying cannot be done with a spray that varies, and it is most important not to exceed the capacity of either the pump or the pipes.

Pressure Gauges. These are very delicate instruments, but receive very rough treatment, so that they are frequently out of order and quite misleading. Differences between the gauge at the pump and another at the lance, actually recorded during last season were as follows:—50, 125, 100, 280, 125, 200 and 100. It is true that the gauges were not calibrated, and, therefore, the difference shown is not always correct, but the gauge used at the lance end was always the same, and the great variations show that either the pump gauges were wrong, or that much pressure was being lost en route. A new gauge may usually be accepted, but on the whole the grower's eyesight is likely to be more useful than a gauge that is not new.

Conclusions. When spraying from a central plant, or through portable pipes, a 2-ft. lance with double nozzle is adequate for bush trees and fruit bushes. For half-standard trees a 4-ft. lance (though 6-ft. may be used, if the pressure is otherwise insufficient to carry the spray to the tops of the trees) fitted with a triple nozzle with 15° bend and 4/64th discs, gives better carry than a double nozzle with 5/64th in. discs. For very large trees, requiring 350 to 400 gal. per acre of summer wash, a 4-nozzle head without bend is most suitable, but it cannot be used on a lance longer than 4 ft., nor if the pressure is insufficient to drive the spray to the tops. When spraying from a mobile outfit, one or two lances, each with 3 or 4 nozzles, according to the capacity of the outfit, may be used.

In all the circumstances mentioned, the sizes of disc required are 4/64th in. for a nozzle pressure of 350 to 500 lb.

per sq. in., and 5/64th in. for pressures of 200 to 250 lb. When a long drive is required the 7-hole swirl plates are needed, but for close work a 6-hole plate (i.e., omitting the centre hole) is better.

The only conditions in which this type of spray is unsuitable, are when it is really windy. Then it is too easily blown away and does not reach the tops of the trees effectively. Such conditions seldom occur throughout Kent and the Eastern counties, and it is usually possible to wait for better weather. At Long Ashton Research Station, however, and at other spots in the West of England and West Midlands, long spells of windy weather are frequently encountered, and Dr. T. Swarbrick has repeatedly stated that he must spray when a 15- or 20-mile an hour wind is blowing. Under such conditions the tops of tall trees cannot be reached effectively unless a very coarse type of spray is available for that purpose. So coarse must be the spray that it is most undesirable to use it for the nearer parts of the tree, and this variation can only be achieved with a gun. The writer believes that this is the real answer to the fixed spray v. gun controversy, although a gun could perfectly well be made for use under less windy conditions without having any part of its range of sprays really coarse.

WIREWORMS AND SUGAR-BEET

F. R. Petherbridge, M.A.,
School of Agriculture, Cambridge

Observation over a number of years supports the opinion that the wireworm is the most destructive insect pest of sugar-beet.

The most severe damage is usually found on land that has been recently broken up from grass. The reason for this is that wireworms normally inhabit grass land and occur in much greater numbers there than elsewhere. Records show that the worst attacks occurred on crops grown in the first two seasons after the ploughing up of old grass land, but bad attacks have been encountered in crops grown in the third and fourth years after old grass. This is because the wireworms live for four or five years in the soil before they are fully fed. The worst damage is done when the seedlings are very young and readily destroyed by the feeding of the wireworms on the stems just below ground. When a second drilling is made the plants from this are occasionally badly attacked, but often a sufficient number of plants remain to make a satisfactory crop. Plants may be killed after singling, when considerable gapping and consequent loss of crop is brought about. Gapping as a result of wireworm injury is very widespread. Observations suggest that wireworm damage is much worse in clean fields than in fields containing a number of grass weeds or rotting turfs.

There is clearly a great need for some treatment to reduce the losses caused by wireworms to sugar-beet, and the following preliminary note on a method successfully used in 1937 is published in order that growers who have to sow beet on fields known to be subject to wireworms may have an opportunity of testing it during the coming season.

Experimental. In 1936 a number of preliminary experiments that aimed at establishing the first sowing of sugar-beet in wireworm-infested fields were carried out on various farms in the eastern counties, and in these the best results were obtained by drilling wheat between the rows of beet. The experiments were not designed to kill the wireworms.

In 1937 experiments were carried out to test the value of drilling wheat between the rows of beets, combined with extra seeding. In March and April a number of fields were visited and examined for wireworm by digging with a fork. Six fields were selected as they appeared to offer promise of a

wireworm attack, and experiments were carried out in these. At five centres the wireworm attack was insufficient or too irregular in distribution to be of use in determining the value of this method, but at the sixth centre there was a general attack of wireworms and very satisfactory results were obtained.

The field was situated in Methwold Fen near Southery. The soil in this field was a black fen. The previous cropping had been—up to 1935, grass; 1936, chicory. Before cropping the field had been thoroughly cleaned and all turf removed. In 1936 the chicory crop was entirely destroyed by wireworm. In 1937 sugar-beet was drilled on April 30, and at this time wireworms were extremely abundant in the surface soil and many were congregating around the few weeds present. The beet rows were 312 yards in length and each treatment consisted of a drill-width of 4 rows, 24 inches apart. The drill used had a double set of coulters, the first set drilling artificial manure which was delivered slightly deeper than the seed. In this way 3 cwt. per acre. of bone superphosphate was drilled under 15 lb. per acre of sugar-beet seed, variety Klein E. The experimental rows were drilled as follows:—

Treatments.

1	Seed rate	15 lb.	per acre	plus phosphate.	
2.	,, ,,	,,	,,	,, ,,	plus wheat between the rows
3.	,, ,,	20 lb.	per acre	plus phosphate	plus wheat between the rows
4	,, ,,	20 lb	per acre	plus phosphate.	
5.	,, ,,	15 lb	,,	,, ,,	
6	,, ,,	10 lb	,,	,, ,,	
7.	,, ,,	15 lb.	,,	No manure.	
Rest of field	,, ,,	15 lb	,,	plus phosphate	

The wheat was drilled separately, after the sugar-beet seed had all been drilled, by running the drill up the rows between the sugar-beet. The drill was set to sow 15 lb. sugar-beet seed per acre; actually the wheat was sown at the rate of about 45 lb. per acre. The wheat used was a mixture of varieties known to have a satisfactory germination percentage, which is essential.

On May 17 the sugar-beet and wheat were well up and the following notes made:—

Treatments.

1. Thin plant.
2. Fair plant. No obvious wireworm damage. Wireworm in wheat rows.

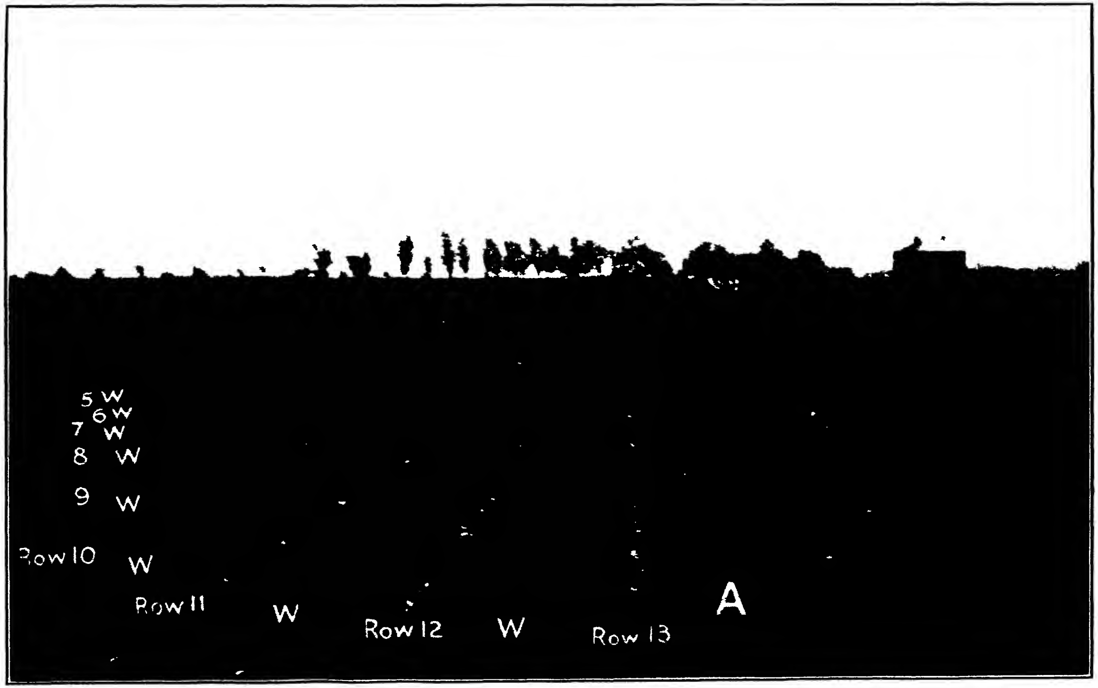

FIG. 1.—Sugar beet on May 25—First Drilling. Sugar beet Rows numbered as in Table III.
Rows to the right of A: No Wheat.
left: Wheat between the Rows.

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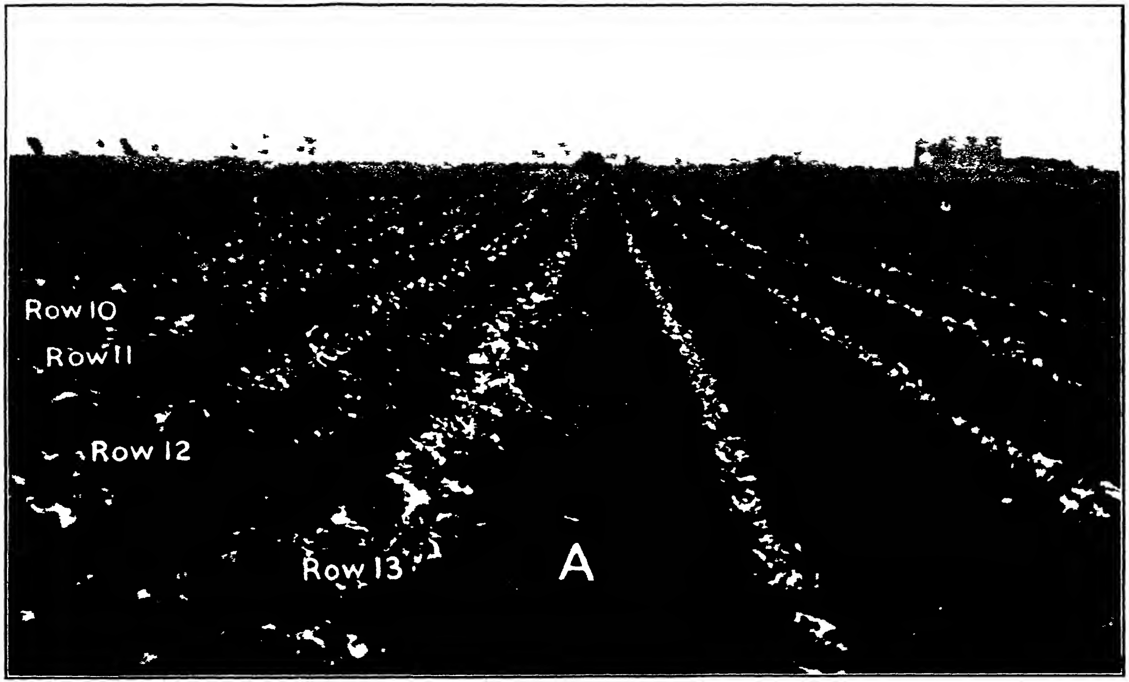

Fi ... Sugar b t ... 1 n ... Sugar beet Rows numbered as in Table III
Rows to left of A —First Drilling (April 30 Plants singled
right Redrilling (May Plants not singled

Treatments—continued.

3. Almost a perfect plant Much damage to wheat. Wireworm in wheat rows.
4. First row (next to Treatment 3) almost perfect. Next three rows patchy. Much wireworm damage.
5. Thin plant. Small lengths killed by wireworm.
6. Very thin plant.
7. Very thin plant.

Rest of field. Thin plant or very thin plant.

On May 20 oblong blocks 2 ft. long × 1 ft. wide between the rows were dug up and the wireworms present counted. The figures obtained are as follows:—

TABLE I

COUNTS OF WIREWORMS *May* 20

Treatment	No. of Wireworms Average for 30 Blocks.
3. 20 lb. seed plus wheat ..	4·6 ± 0·43
4. 20 lb. seed, no wheat	1·9 ± 0·35

These figures suggest that wireworms were definitely attracted by the wheat.

Counts of seedlings were made on the same day. These give some indication of the degree of attack on each of the treatments.

TABLE II

NO. OF SUGAR-BEET SEEDLINGS PER FOOT LENGTH OF ROW AT RANDOM. *May* 20.

Treatment.	Total for 60-foot lengths	Average per foot length.	No. foot lengths without seedling
1	253	4·21	10
2	376	6·27	6
3	1,317	21·95	1
4	448	7·47	13
Rows 37–40 as Treatment 1	97	1·61	34

With the exception of the seven rows with wheat on both sides and the two outside rows with wheat on one side only (i.e., four rows of Treatment 2, four rows of Treatment 3, and one row of Treatment 4), by May 25 the whole field, except a few rows near one side, was useless as a stand of sugar-beet and was prepared for re-drilling, which was carried out on May 26.

THE COST OF CONTROLLING CONTAGIOUS ABORTION IN A LARGE SELF-CONTAINED HERD

A. D. McEwen, D.Sc., M.R.C.V.S.,

Veterinary Department, South-Eastern Agricultural College, Wye, Kent

The control of a contagious disease such as contagious abortion or tuberculosis is often regarded as an expensive undertaking, and not a matter that the farmer can afford to attempt without financial assistance or reward. The chief inducement to the eradication of tuberculosis has been, and still is, the enhanced price receivable for milk from tuberculin-tested herds. There is no comparable stimulus to the eradication of contagious abortion, but many farmers are interested in the control of this disease, and some have undertaken its eradication from their herds, while others spend considerable sums of money on vaccination or alleged cures.

If farmers were conversant with a plan for the eradication of contagious abortion, and if the cost of the plan were not prohibitive, it is probable that more of those who are in a position to do so would undertake eradication. The present paper endeavours to give an account of the cost of the control of contagious abortion in a large dairy herd where the circumstances were favourable to eradication, and to illustrate that the cost of following a plan of eradication need not be expensive.

Eradication was started in this herd because the owner decided that it was advisable for him to have abortion-free animals for sale, disappointment having been occasioned by abortions occurring among heifers recently sold from the farm although the number of abortions that had taken place in the herd itself had not reached an alarming figure. Yet a preliminary test carried out on the cows showed that 66 out of a total of 182 gave a positive reaction for contagious abortion and 17 showed a doubtful reaction; the remainder were negative to the test.

Four different dairy groups, each with its respective pastures separated from the others and from neighbouring farms, were used to accommodate the herd. It was decided to place all the infected and doubtful cows in one dairy and to keep

non-reacting animals only at the others. Later, however, it was found necessary to keep a number of the non-reactors at the dairy where the infected cows were.

The plan for the control, and it was hoped eventual eradication of the disease, was simple; if it succeeded it should cost little, but if it failed no financial sacrifice would have been made. It was arranged that blood samples from all non-reacting animals, which were or had been in milk, should be tested at regular intervals. These tests constituted the general herd tests. As a negative reaction in the pregnant cow or heifer cannot always be relied upon as evidence of absence of infection, all non-reacting animals were isolated at calving or at aborting and not returned to the non-reacting portion of the herd until they had passed a test. Herd tests were carried out every two months at the dairies containing only non-reacting animals, until three consecutive herd tests had been passed without any reactor appearing during this time; thereafter the herd tests were made at 6-monthly intervals. The non-reactors in the dairy containing infected cows have, since the plan started, remained at 2-monthly herd tests because of the danger of infection spreading from the latter. The doubtful reactors were tested regularly and some became positive while others were eventually passed as non-infected. Heifers were tested before or soon after service. It was considered essential to keep the cost of eradication as low as possible, and many of the reacting cows that were valuable animals were not sold off because they reacted to the test for contagious abortion, but were retained and only disposed of when a favourable opportunity involving the minimum of loss presented itself. Many of these animals, however, had to be sold because of disease that had no connexion with the plans for the control of contagious abortion.

The policy was the eventual elimination of reacting animals without undue sacrifice.

As the abortion-reacting animals were sold so it became necessary for the economic working of the dairy where they were kept to introduce non-infected animals to maintain the numbers, and with the passage of time the number of infected stock diminished, while that of the non-infected increased. The reacting and non-reacting groups, though in the same milking shed and attended by the same men, were kept apart as far as possible and grazed on different pastures. The keeping of infected and non-infected animals in close

proximity to one another is to be avoided where possible, but unless accommodation is exceptionally abundant it may not be practicable during certain phases of the eradication of the disease. On the farm in question it has worked well, there being no evidence of the disease having spread from the reactors to the non-reacting cows, although there is the possibility that one young animal became infected from the reactors. The first herd test that showed the presence of 66 reacting animals was made in November and December, 1931. Between that test and May, 1933, 18 more cows became positive reactors, but since then and until the herd was sold in October, 1937, only one fresh reactor appeared in the entire herd. This was a young heifer that probably became infected through drinking milk from infected cows. The breeding histories of the non-reacting animals have been satisfactory, there being practically no sterility, and out of 710 pregnancies 698 ended normally. In 3 instances the foetuses were fully formed but dead, and 2 premature but living calves were born. Only 7 pregnancies ended in abortion. Therefore, 98 per cent. of all pregnancies ended normally, which is satisfactory. It should be noted that none of the abortions was caused by infection with *Br. abortus*.

The breeding histories of the reacting animals retained in the herd were not so good, there being 145 pregnancies, 21 of which terminated in abortion and 4 in the delivery of full-time but dead calves; 17 per cent. of the pregnancies therefore terminated abnormally.

Table I gives particulars regarding the length of time reacting animals were maintained in the herd after having reacted to the test, and also shows the number of pregnancies each of the animals has had and how these terminated.

TABLE I

No. of Cow	*Time Kept on Farm after Reacting to Test*	*Pregnancies Terminated before Testing*		*Pregnancies Terminated after Testing*	
		Normal	*Abortion*	*Normal*	*Abortion*
5 ..	19 months.	7	0	1D	1
8 ..	16 „	7	0	2	0
13 ..	19 „	?	0	2	0
15 ..	26 „	2	0	1	0
18 ..	16 „	4	1	1	1
19 ..	60 „	?	0	5	0
22 ..	24 „	1	1	1	1
25 ..	15 „	?	0	1	0
28 ..	21 „	?	0	2	0
29 ..	21 „	?	0	2	0

TABLE I—*continued.*

No. of Cow	Time Kept on Farm after Reacting to Test	Pregnancies Terminated before Testing		Pregnancies Terminated after Testing	
		Normal	Abortion	Normal	Abortion
35	40 months.	?	?	4	0
38	9 ,,	10	0	0	1
40	Still in herd.	6	0	4	0
41	60 months.	?	1	3	0
42	10 ,,	?	0	1	0
43	10 ,,	?	?	0	1
46	27 ,,	5	1	2	0
76	Still in herd.	0	0	3	1
77	21 months.	?	0	2	0
82	11 ,,	0	0	2	0
94	Still in herd.	?	?	4	2
99	24 months	?	?	1	0
102	24 ,,	?	1	1	0
108	21 ,,	0	0	2	0
109	18 ,,	6	0	1	0
118	66 ,,	?	1	5	0
120	Still in herd.	7	0	3	0
122	22 months.	1	0	1, 1D	0
128	40 ,,	6	1	3	0
129	14 ,,	1	0	1	1
130	10 ,,	?	0	1	0
131	Still in herd.	6	1	5, 1D	0
137	18 months	1	0	1	1
138	11 months.	7	0	1	0
141	15 ,,	3	0	1	0
142	7 ,,	1	0	1	0
145	21 ,,	3	0	1	0
147	Still in herd.	2	0	6	0
148	10 months.	2	1	1	0
153	6 ,,	?	?	0	0
157	25 ,,	1	0	3	0
176	23 ,,	2	1	2	0
177	24 ,,	1	0	0	1
178	23 ,,	1	0	0	1
179	18 ,,	0	0	1	1
183	27 ,,	2	2	2	0
187	40 ,,	6, 1D	0	2	0
188	10 ,,	4	2	1	0
189	3 ,,	4, 1D	0	0	0
190	17 ,,	3, 2D	0	1	0
191	21 ,,	5	1	0	1
193	40 ,,	5	1	3	0
194	11 ,,	4	0	1	0
197	8 ,,	4	0	0	0
200	15 ,,	1	0	1	0
204	4 ,,	4	1	1	0
205	5 ,,	6	0	1	0
207	7 ,,	1	1	0	0
208	18 ,,	4	0	1	0
209	3 ,,	4	1	1	0
213	3 ,,	7	1	1D	0
214	7 ,,	3	1	1	0

TABLE I—*continued.*

No. of Cow	*Time Kept on Farm after Reacting to Test*	*Pregnancies Terminated before Testing* *Normal*	*Abortion*	*Pregnancies Terminated before Testing* *Normal*	*Abortion*
216 ..	4 months.	[illegible]	0	1	0
217	5	1, 2D	2	0	0
219	27	3	0	1	0
221	10	0	1	1	0
222	11	3	0	0	1
225	46	1	0	3	0
227	11	1	0	0	0
229	31	1	0	1	1
230	11	0	1	0	0
232	31	0	0	2	2
234	22	1D	0	1	0
236	16	1	0	0	0
237	18	0	1	0	1
242	7	?	?	0	0
243	27	4, 1D	0	1	0
244	24	2	0	1	1
245	16	1	0	1	[illegible]
246	17	1	0	1	0
247	23	0	0	2	0
248	39	0	0	3	1
250	15	?	?	?	?
256	7	3	1	0	0

Note.—D = calved full time but dead.

No monetary expenses were incurred by the owners of the herd in connexion with the testing of blood samples or the bacteriological examination of foetuses or milk samples, beyond those incidental to the despatch of material to the laboratory. The blood samples were always collected from an ear vein, this being a simple procedure and not upsetting or distressing the animals.

In estimating the cost of controlling the disease consideration need only be given to the losses incurred through the sale of animals owing to their being reactors to the test. Reference to Table II shows that most of the animals were sold for reasons quite independent of the eradication plan, and the losses on these animals were in no way attributable to the eradication plan. Some animals were sold after aborting, it being no longer profitable to retain them until another calving, but the losses so sustained are again not attributable to the eradication plan, as the animals would have aborted and would have been sold had the plan not been followed. In some instances the knowledge that an animal was a reactor, when coupled with the appearance of another unsatisfactory characteristic determined in favour of

her disposal from the herd. These animals were regarded as having been sold because of two reasons, the eradication plan being one of them, and half the loss incurred was debited to the plan.

As already mentioned the aim was to get rid of reacting cows with the minimum of sacrifice, and animals that were breeding normally and otherwise healthy were sold only where favourable opportunities offered. The losses from such sales were not heavy and they were debited to the eradication plan.

At the annual stocktaking, valuations were placed on each nimal. The difference between the valuation and the price realized when animals were sold was estimated as a profit or loss. At the time of making the valuations the animals that were earmarked for sale for some reason other than their positive reaction to the test for contagious abortion were written down in value; hence the losses from the sale of such animals which were not connected with or attributable to the eradication plan are probably underestimated.

Since the disease was brought under control the surplus non-reacting stock have been sold at an annual herd sale as abortion-tested animals. The holding of these sales was made possible by following the eradication plan, which automatically increased the value of the non-reacting animals. Animals reacting to the test for contagious abortion could not be valued as highly nor sold at such a high figure as non-reactors, but their lower value in comparison with that of the non-reactors cannot be considered as a loss due to the eradication plan.

Table II gives particulars of numbers of animals disposed of for different reasons, their valuation and sale prices, and the estimated loss. In Table III the particulars are summarized.

TABLE II

ANIMALS REACTING TO THE TEST FOR CONTAGIOUS ABORTION

Losses Due to Causes not connected with the Eradication Plan

No. of Animals	*Valuation*	*Price Realized at Sale*	*Loss*
Animals sold because of abortion occurring at a time when it was considered unjustifiable to maintain them until another calving :—			
4	£103 0 0	£32 18 0	£70 2 0
Animals sold because of sterility :—			
6	£135 0 0	£53 0 0	£82 0 0
Animals sold because of mastitis :—			
7	£190 0 0	£55 6 6	£134 13 6
Animals sold because of Johne's disease or wasting :—			
5	£100 10 0	£24 0 0	£76 10 0

TABLE II—*continued.*

No. of Animals		*Valuation*	*Price Realized at Sale*		*Loss*
Animals sold for unspecified reason :—					
1	..	£20 0 0	£6 0 0	.. ..	£14 0 0
Animals sold because of a positive reaction to the tuberculin test :—					
16	..	£412 5 0	£262 2 6	.. ..	£150 2 6
Animals sold because they were poor milkers :—					
2	..	£36 0 0	£26 0 0	.. ..	£10 0 0
Animals sold because of two causes affecting their value, *the loss incurred by the sale being divided equally between both causes* .—					
				Abortion of calf	Poor milking capacity
2	..	£60 0 0	£16 2 6	£21 18 9	£21 18 9
				Sterility	Poor milking capacity
1	..	£35 0 0	£8 10 0	£13 5 0	£13 5 0
				Sterility	Reaction to tuberculin test
1	..	£30 0 0	£7 5 0	£11 7 6	£11 7 6
Animals sold because they reacted to the test for contagious abortion and for some additional reason, *the loss being divided between the eradication of the disease and the other reason for disposal* .—					
				Eradication plan	Poor milking capacity
3	.	£65 0 0	£36 10 0	£14 5 0	£14 5 0
				Eradication plan	Mastitis
1	..	£20 0 0	£6 0 0	£7 0 0	£7 0 0
Animals which died or were destroyed on account of old age, and for other reasons —					
3					

Losses Attributable to the Eradication Plan

Animals sold because of a reaction to the test for contagious abortion .—				
26	..	£695 10 0	£686 5 6	£9 4 6
Heifer slaughtered because of a reaction to the test for contagious abortion. Estimated loss	..	.. ..		£10 0 0

TABLE III

The figures given in Table II are summarized as follows .—

	£	s	d.
Losses due to abortions	92	0	9
,, ,, sterility	106	12	6
,, ,, mastitis	141	13	6
,, ,, Johne's disease and wasting ..	76	10	0
,, ,, poor milking capacity	59	8	9
,, ,, tuberculin test	161	10	0
,, ,, non-specific reasons	14	0	0
	£651	15	6
Total losses caused through the disposal of animals not associated with the eradication of contagious abortion	£651	15	6
Total losses due to the disposal of animals because of their reacting to the agglutination test for contagious abortion and therefore attributable to the eradication plan	£40	9	6

Six of the originally-reacting cows were still on the farm at the end of the period under consideration, having been kept because they were valuable breeding stock. Three of the remaining 78 reacting cows died or were destroyed, but not on account of any specific disease, and they are not shown as occasioning financial loss. The rest of the cows were sold for the reasons shown in Table II and III. The heifer that reacted after May, 1933, was slaughtered for experimental purposes, but had she been sold because of a reaction to the test a loss would have been incurred. This loss has been estimated at £10 and it is shown in the Tables. The Tables show that the losses sustained by the sale of reacting animals, attributable to the eradication plan, amounted to the small sum of £40 9*s*. 6*d*., which represents the cost of effectively controlling the disease in the whole herd for six years.

The much greater sum of £651 15*s*. 6*d*. was lost through sale of reacting animals because of disease or other undesirable qualities not connected with the control of contagious abortion, and which would have come about had control not been attempted. It should also be remembered that this larger sum represents the losses from a portion of the herd only, and had the whole herd over a 6-year period been considered the losses from disease and the other undesirable qualities would have been much greater.

Contagious abortion is acknowledged to be one of the most important diseases of cattle, and it is probably responsible for greater economic loss to farmers than is tuberculosis. It is therefore instructive to find that over a period of nearly 6 years, during which time the disease has been successfully controlled, the costs of control, which are represented by the losses sustained in selling cows because they reacted to the test, amounted to only a small portion of the losses sustained from tuberculosis in a section of the herd, the herd being self-contained, tuberculin-tested, and licensed by the Ministry of Health to sell tuberculin-tested milk.

The amount saved by the successful control of the disease cannot be estimated, as the extent to which infection might have spread had control measures not been enforced is unknown, but it is most probable that further spread would have occurred, the losses from which would have been considerable.

An indication of the extent to which the milk yield may be diminished by abortion is given by the figures in Table IV, compiled from the milk yields of 33 cows that had aborted.

The complete records of milk yields following abortion are compared in some instances with the complete records of the previous normal lactation, and in other instances with the complete records of the milk yield of the next normal lactation following the abortion, and they show that as a result of 33 abortions there was a total loss of 71,436 lb. of milk, or an average of 2,164 lb. of milk at each lactation following an abortion. If this were expressed in terms of cash it would represent a considerable sum of money lost per aborting cow.

TABLE IV

RECORDS OF THE MILK YIELD BEFORE ABORTION COMPARED WITH THE MILK YIELD FOLLOWING ABORTION

No of Cow	*Lactation before Abortion*				*Lactation after Abortion*			*Difference in lb between a Normal Lactation and a Lactation following Abortion*
	No of Lactations	*No of Days in Milk*	*No of lb of Milk*	*No of Months Premature*	*No of Lactations*	*No of Days in Milk*	*No of lb of Milk*	
5	6th	240	9,510	4½	7th	226	3,682	− 5,828
22	1st	210	5,985	3	2nd	228	5,100	− 885
30	1st	361	8,450	2	2nd	289	4,526	− 3,924
38	1st	357	7,487	3	2nd	242	7,163	− 324
41	1st	294	8,820	?	2nd	249	4,519	− 4,301
43	3rd	333	9,247	1	4th	268	5,189	− 4,058
46	2nd	274	6,632	1¾	3rd	312	5,366	− 1,266
82	1st	189	4,175	4	2nd	276	4,288	+ 113
94	1st	314	5,873	3	2nd	252	4,583	− 1,290
128	4th	304	7,656	?	5th	281	4,999	− 2,657
131	4th	244	6,972	2½	5th	244	6,237	− 735
137	1st	275	5,408	2	2nd	146	2,128	− 3,280
148	1st	344	6,368	2½	2nd	324	5,241	− 1,127
176	1st	360	5,844	2	2nd	234	3,345	− 2,499
177	1st	332	8,549	2¾	2nd	360	6,864	− 1,685
178	1st	284	5,129	1¼	2nd	364	6,454	+ 1,325
179	1st	307	8,247	3	2nd	349	7,224	− 1,023
188	2nd	361	10,180	2½	3rd	250	6,971	− 3,209
191	2nd	362	13,622	1½	3rd	298	7,118	− 6,504
193	1st	297	8,021	2	2nd	269	5,912	− 2,109
204	1st	231	4,105	2	2nd	233	3,802	− 303
209	1st	311	6,781	1	2nd	288	7,037	+ 256
213	1st	360	6,555	?	2nd	341	4,120	− 2,435
218	4th	304	7,656	?	5th	281	4,999	− 2,657
229	1st	347	7,955	½	2nd	327	5,914	− 2,041
244	1st	362	8,187	?	2nd	307	4,269	− 3,918
					TOTAL ..		..	− 56,374
					Average ..		..	− 2,168

RECORDS OF THE MILK YIELD AFTER ABORTION COMPARED WITH THE MILK YIELD OF THE NEXT NORMAL PREGNANCY

		Lactation after Abortion			Next Normal Lactation			Difference in lb. of Milk between a Normal Lactation and the Lactation following Abortion
No of Cow	No of Months Premature	No of Lactation	No. of Days in Milk	No of lb of Milk	No of Lactation	No of Days in Milk	No. of lb of Milk	
76	1	1st	360	9,202	2nd	293	9,799	— 597
122	?	1st	175	2,521	2nd	330	6,455	— 3,934
183	1	1st	292	5,580	2nd	275	6,198	— 618
188	2½	4th	242	6,863	5th	275	9,677	— 2,814
214	3	1st	365	9,255	2nd	272	10,452	— 1,197
217	?	1st	175	2,521	2nd	330	6,455	— 3,934
348	1½	1st	280	4,671	2nd	302	6,639	— 1,968
						TOTAL . ..		— 15,062
						Average		— 2,151

If the precedent established by the Attested Herd Scheme for assistance in the control of tuberculosis were extended to the control of contagious abortion, and a plan similar to the one adopted in the control of the disease in the herd now reported on, were followed, the cost of eradication in favourably-situated herds might be very small. Even if a charge were made for carrying out the laboratory tests, provided this were a moderate one, the cost of eradication might still be modest. In this herd, just over 4,000 blood samples were tested.

Summary. Over a period of nearly 6 years, contagious abortion has been effectively controlled in a herd of 180 or more cows. At the first test and during the following 17 months 84 animals reacted to the test for contagious abortion. Since then only one reactor to the test has been detected. The reacting animals were kept while it was profitable to maintain them, and 6 of the original 84 reacting animals were still on the farm nearly 6 years after having shown a positive reaction. The losses sustained by the sale of animals because they were reactors to the test for contagious abortion and by the slaughter of one animal because she reacted to the test amounted to £40 9*s*. 6*d*. These losses were the only costs attributable to the control of the disease.

IN SEARCH OF BETTER WALNUTS

JOYCE B. HAMOND, Ph.D.

That the common walnut (*Juglans Regia*) is usually known as the English walnut, in spite of its being indigenous to Persia, and most widely grown in France and California, surely testifies to the tremendous popularity of walnuts in this country. Tons of these nuts are imported each year, and there is a great and ever-increasing demand for them throughout the winter, particularly during the Christmas season.

When one compares the walnuts that are imported from France and America with typical English-grown nuts, one is struck by the difference. The latter are frequently small and dark-coloured, with the two halves of the shell gaping open to reveal an unattractive-looking kernel, often covered by a tough, brown skin, and lacking the true walnut flavour. The foreign nuts are usually of uniform size and are bleached to an attractive light colour. The kernel, which nearly fills the shell, has the rich nutty flavour characteristic of a good walnut, and the surrounding skin is thin and almost tasteless, and therefore need not be removed before the kernel is eaten.

These reflections caused the late Mr. Howard Spence of Southport to wonder whether anything could be done to improve the quantity and quality of the walnuts produced in England, and hence to make us more self-supporting in this direction.[3*] Mr. Spence therefore sought the co-operation of East Malling Research Station and work was started on this subject.[6] The main difference between foreign walnuts and those grown in this country is that the latter are borne on trees raised from seed, whereas the former grow on vegetatively-raised trees of approved varieties. The advantages of growing trees vegetatively as opposed to growing them from seed are too well known to need more than brief reference. Seedling walnut trees may bear good or poor nuts, irrespective of the nut originally sown; moreover, they come into cropping only after fifteen to thirty years, or they may never crop at all. Trees raised vegetatively, that is, by grafting or budding of known varieties, are found to grow exactly similar in all respects to the parent tree. In addition, they have the advantage of coming into cropping considerably earlier than seedling trees. The first step, then, in this cam-

* For references, see page 43.

paign for better walnuts, was to select a few varieties suitable for growing under our climatic conditions.

Many excellent walnut varieties grown in America and in the south of France come into leaf very early in spring; these are therefore quite unsuitable for growing in England, as the young foliage and nutlets are killed off by spring frosts. This being so, a survey of English trees was made some ten years ago by Inspectors of the Ministry of Agriculture, in order to find a few that were worthy of extensive propagation. In addition to this survey, Dr. H. V. Taylor, under the auspices of the Royal Horticultural Society, arranged a most successful Walnut Competition, which was held in the autumn of 1929 and to which owners of British walnut trees were invited to send samples of their nuts. Great interest was aroused, and over 700 entries were received. The standard of judging was, naturally, very high, and only five samples were deemed worthy of further propagation. In judging the nuts, points were allotted for the characteristics set out as follows:

POINTS OF A GOOD NUT

(a) *Size :*	Not less than 1½ in. in diameter
(b) *Weight :*	Not more than 30 to 40 per lb.
(c) *Contour :*	Absence of deep pitting, corrugation or irregularity in form.
(d) *Colour :*	Light brown or golden brown
(e) *Sealing :*	Should not open at all with moderate pressure between finger and thumb
(f) *Cracking :*	Should crack readily with ordinary nutcrackers, and it should be possible to remove the kernel easily without shattering it.

KERNEL

(a) *Colour (with pellicle) :*	Light tan or silvery-brown with glossy appearance.
(b) *Percentage :*	50 per cent of the total weight of crop.
(c) *Plumpness :*	Shell well filled with kernel unshrivelled, brittle—not leathery.
(d) *Flavour :*	Rich, mild and essentially walnut flavour, free from woody taste, with little or no astringency.

A characteristic that was unsatisfactory in the majority of samples was the way in which the two halves of the shells were sealed. Nuts in which the shells open easily remain in good condition for only a very short time. If such nuts are exposed to a dry atmosphere, the kernels quickly shrivel as moisture in them evaporates, and if they are exposed to damper conditions, which are usually suitable for storage, moulds quickly penetrate between the two halves of the shell and attack the kernel. In the course of storage experiments

on walnuts, it has been found that badly-sealed nuts are quite unsuitable for storing under any conditions that have been tried.[2] After wet, sunless summers, badly-sealed nuts are very common, but in the hot, dry summers experienced in the south of France and in California, this trouble is comparatively unknown. After normal English summers, the walnut varieties that are now being propagated should be quite satisfactory from this point of view.

It was frequently found that nuts that were satisfactory in appearance contained only small or comparativly flavourless kernels, and that when the kernel was rich in flavour, the nut was too small for dessert purposes. The richness of flavour of a walnut depends chiefly on the percentage of oil present. During the course of the walnut work at East Malling Research Station, the oil from numerous samples of nuts was tested. It was found that the average kernel of an English-grown walnut contains only approximately 30 per cent. of oil by weight after having been kept at room temperature for about 10 days. The walnuts selected for rapid propagation contain between 50 and 60 per cent. of oil under the same conditions. Walnuts with only a low percentage of oil contain more moisture, and hence, owing to evaporation, they shrivel on storing. Walnuts containing more oil have a lower percentage of moisture and hence remain comparatively unshrivelled on storing.

The five selected trees are growing in private gardens or small orchards in the south of England; two in Kent, two in Suffolk and one in Gloucestershire.[1] The tree that bore the first-prize-winning nuts in the class for fresh walnuts is in the village of Ixworth in Suffolk. These nuts reach a very high standard, and are particularly noteworthy in that the shells are very smooth and regular in contour. Thus, an unbroken kernel may easily be obtained on cracking a nut. Another of the five chosen trees that is also situated in Suffolk, near Ipswich, bears nuts that gained full marks for external characteristics, as they are of excellent size, weight, and colour, and are very well sealed. The kernel is not quite proportionately large, but the flavour is rich and it remains in good condition on storing. The chief characteristic of a chosen tree growing in a private garden in Dartford is that the nuts, which are larger than the average, are exceptionally well filled.

Trees bearing the large type of walnut known as "double"

nuts, or "Bannuts," are not usually of value for propagation as they normally contain very small kernels in spite of their large shells. The "double" nuts growing on a young tree in Margate are exceptional in that the kernel is proportionately large. Although these nuts are not of outstanding flavour, they have been included on account of their appearance and filling. Finally, the tree that bore the first-prize-winning nuts in the class for dried walnuts is in Gloucestershire. As would be expected, the chief characteristic of these nuts is their rich flavour, as they contain an exceptionally high percentage of oil and hence remain practically unshrivelled on storing.

In addition to these five native trees, two more were selected for pickling purposes. These are situated in Kent and Sussex respectively, and are peculiar in that they bear large, grape-like clusters of small nuts that have been tested by two well-known London firms and found to be especially suitable for pickling. These native trees having been provisionally selected for rapid propagation on account of their nuts, it was necessary to take records of them over a period of at least three years, in order to be certain that they were satisfactory in other respects. It is most important that these trees should be growing strongly and bearing regular crops, and that they should be free from disease. As mentioned above, they must also remain dormant until late in spring; by so doing, not only are the late frosts avoided, but risk of infection by a bacterial disease, that spreads quickly in the mist and rain of early spring, is greatly minimized.

The last point to be ascertained was that the selected trees were self-fertile. Walnuts normally bear both staminate and pistillate flowers on the same tree, but, unless these mature at the same time, pollen is not available to fertilize the nutlets, which would then develop only if pollen were brought by wind from another tree. Trees that are thus cross-pollinated do not bear nuts if planted singly, and would therefore be unsuitable for extensive propagation. All the selected English trees have been found, over a three-year period, to be satisfactory from all these points of view.

Since making these English selections, graftwood from some sixty foreign varieties has been collected, and the resulting trees have been tested under our climatic conditions with the object of finding some suitable for distribution in this country. Most varieties from India and the Far East, and many from South America, have proved unsuitable for this

climate on account of an early-leafing habit. These varieties are also frequently unsuitable because their wood fails to ripen in our temperate summer, and is consequently killed back in winter. Thus, even if these trees survive, they remain stunted and unhealthy.

More success has been obtained, however, in growing European varieties, particularly those from France. Following observations made for several years on young trees growing at East Malling Research Station, four foreign varieties have now been chosen for rapid propagation in England. These are the four well-known French walnuts, Franquette, Mayette, Meylanaise and Treyve. These varieties are all hardy and late in leafing-out; they also bear excellent dessert nuts. In addition, the variety Meylanaise is interesting as it has been found to bear catkins during the first few years. Most grafted trees bear only nutlets during the first five years, and the nutlets mature only if they are fertilized by pollen from an older tree. After this time, both types of flower are borne on grafted trees. As it is precocious in bearing catkins, the variety Meylanaise should bring about early cropping if planted up with other young walnut trees.

On completion of the necessarily slow and arduous work of selecting a few varieties suitable for growing in this country, recent work has been directed chiefly towards finding good methods of propagation. Young trees may be grafted under glass on to one-year-old seedling walnut stocks. This work is carried out in the early spring with dormant wood, or in summer with herbaceous scions. About 70-80 per cent. success is usually obtained at either time of the year.[4, 5]

Hitherto, little success has been obtained with grafting or budding out-of-doors. This is chiefly because the walnut is very slow to form callus tissue, and the scions tend to dry out before they have united with the stocks. Budding has given more satisfactory results than grafting, so that attention has lately been concentrated on this, and although still only at an experimental stage, a promising technique is now being evolved.

A big and increasing demand for budded and grafted walnut trees for dessert and pickling purposes, as well as for timber, has now been created. The trade is taking over the production of these trees, but only a small amount will be available for a few years, owing to the limited amount of graftwood and the slow development of the young trees. When

funds again become available for walnut research, the necessary experimental work, now largely in abeyance, will be resumed.

In considering the scope of this work, an interim period during which the trees would come into cropping and prove their worth was always anticipated.

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CENSUS OF FRUIT PRODUCTION IN ENGLAND AND WALES, 1936

As part of the quinquennial census of production an inquiry was undertaken in 1936 to ascertain direct from growers not only the quantity of fruit of each kind produced in that year, but also the numbers of the different orchard trees. Whilst the growers' returns of production thus furnished a comparison with the annual estimates made by the Ministry, the enumeration of trees, which was last undertaken in 1931, provided a more up-to-date basis for estimating the production of orchard fruit in years intervening between census inquiries.

The full results of this census will be published shortly in Agricultural Statistics (Part II) for 1936, but brief particulars are given below.

Forms were sent on October 31, 1936, to 70,696 occupiers of agricultural holdings in England and Wales, being those whose June 4 returns showed any acreage devoted to fruit of any sort. Unlike the statutory June returns the completion of the census questionnaires is voluntary, but about 52 per cent. of the forms were returned, and 46 per cent. (representing 41 per cent. of the total fruit acreage) were suitable for inclusion in the summaries from which estimates were made of the total number of trees and of production. Although the response to the census was not as general as could be desired, the sample provided a sufficiently large working basis, and, in the absence of evidence to the contrary, the Minister has assumed that the sample was representative.

Orchard Fruit. In the following table the number of trees and production have been obtained directly from the census; the acreage is that obtained from the annual returns; and from these figures the other figures shown have been calculated. Although the basis used for estimating the annual production of orchard fruit is that of yield per tree, the table includes as a matter of interest the yield per acre.

Fruit Production—1936

Acreage, Estimated Number of Trees and Estimated Yield and Production of Orchard Fruit in England and Wales

	Acreage June 4 1936	No. of trees	Average No. of trees per acre	Production	Av. Yield per acre	Av. Yield per tree
		(000's)		(000's cwt.)	(cwt.)	(lb.)
Dessert and Cooking Apples ..	116,184	13,325	114	6,300	54·2	52·9
Cider Apples ..	67,310	2,795	41	1,917	28·5	76·8
Perry Pears ..	5,500	168	30	170	30·9	113·1
Dessert and Cooking Pears .	11,618	1,775	151	557	48·0	35·2
Cherries ..	15,446	784	51	329	21·3	46·9
Plums and Damsons .. .	43,402	6,049	138	2,388	55·0	44·2
Nuts	1,855	551	296	35	19·1	7·2

Dessert and cooking apples accounted for 44 per cent. of the orchard acreage, 52 per cent. of the total fruit trees, and 54 per cent. of the estimated gross weight of orchard fruit produced in 1936. Cider apple orchards covered 26 per cent. of the total acreage, but the density of trees being very little more than one-third that of other apple trees, the trees formed only 11 per cent. of the total orchard trees. The yield of cider apples at 77 lb. per tree was, however, greater than that of other apples (53 lb. per tree) and cider apple production amounted to 16 per cent. of total orchard fruit.

Excluding nuts, the greatest density of all fruit trees was recorded in dessert and cooking pears at 151 per acre, and the lowest in perry pears at 30 trees per acre, whilst the greatest yield per tree of any orchard fruit was that of perry pears at 113 lb., and the lowest that of dessert pears at 35 lb. About one-sixth of the total orchard area was devoted to plums, including damsons, the trees comprising nearly a quarter of the total number of fruit trees and accounting for over one-fifth of total weight of fruit production. About 8 per cent. of the aggregate acreage under orchards was also producing small fruit.

Small Fruit. The production of small fruit in England and Wales as shown by the 1936 census is given below, the yield being calculated therefrom on the acreage shown in the June returns. Nearly 38 per cent. of the total small fruit area consisted of orchards with small fruit between the trees.

Fruit Production—1936

Acreage and Estimated Yield and Production of Small Fruit in England and Wales

	Acreage	Production	Average Yield per Acre
		(thousand cwt.)	(cwt.)
Strawberries	24,635	369	14·8
Raspberries .. .	5,780	88	14·4
Blackcurrants ..	9,772	136	13·2
Red and White Currants ..	2,574	28	9·8
Gooseberries	10,370	263	24·4
Loganberries and Blackberries	2,571	72	27·2

Land devoted to strawberries occupied 44 per cent. of the total small fruit acreage, which fruit comprised 39 per cent. of the total weight of small fruit. Gooseberries and black-currants accounted for roughly one-fifth and one-sixth of the total acreage respectively and raspberries for one-tenth. Another tenth of the small fruit acreage was shared equally between red and white currants, and loganberries and cultivated blackberries. The census figures for production gave a yield for red and white currants of less than 10 cwt. per acre. The yields of strawberries, raspberries and black currants were between 13 and 15 cwt. per acre. Yields of gooseberries, and of loganberries and blackberries, were higher at 24½ and 27 cwt. per acre respectively, gooseberries accounting for 28 per cent. of the total weight of small fruit.

Comparison of 1936 Fruit Census Results with Ministry's Estimates. The Ministry has made and published each year estimates of the production of orchard and small fruit, based on the information obtained through the previous census inquiries in 1925 and 1931, on the annual returns of acreage of small fruit and on estimates received of the yield per tree or, in the case of small fruit, of the yield per acre, for the year in question.

The 1936 census inquiry has furnished more up-to-date information in regard to certain of these basic particulars and the estimates of fruit production already published for 1936 therefore need revision. The average yields derived from the census inquiry are generally below those used for the Ministry's estimates for 1936. It is probable that, in part at least, the difference has arisen because growers have estimated their production on the basis of their sales, and

have not allowed for the quantity of fruit, amounting possibly to 15 per cent. of total production, which was used in growers' households, was wasted or otherwise unsold. It will be appreciated that estimates based on sample inquiries, which cannot, for example, take full account of trees not in bearing, must necessarily be subject to some margin of error.

Comparison of Results of the 1925, 1931 and 1936 Fruit Censuses in England and Wales. Owing to the predominance of weather in the determination of yield, comparison of yield or production of any one fruit between one year and another is virtually a reflection of weather conditions if no material change has occurred in the acreage under that fruit or in the numbers of trees. Interest in the following series of tables centres therefore mainly in the difference between the three censuses in regard to the estimated numbers of orchard trees, and in the acreage of small fruit. Particulars of the latter are, however, given yearly in Agricultural Statistics (Part I).

Between 1925 and 1931 dessert and cooking apple trees and plum, including damson, trees increased in number, and 1936 recorded a further substantial increase, amounting to 7 per cent. in apple trees and 12 per cent. in plum trees. Cider apple trees more than recovered from the drop in number between 1925 and 1931, the increase over 1925 being nearly 3 per cent. Pear trees of all kinds and cherry trees were fewer in 1936 than in 1931, although cherry trees were more numerous than in 1925. The fall in perry pear trees since 1931 amounted to 8 per cent, and in dessert and cooking pear trees to over 1 per cent.

I.—ESTIMATED NUMBERS OF ORCHARD TREES (THOUSANDS)

	Cider Apple	Other Apple	Perry Pear	Other Pear	Cherry	Plum
1925 ..	2,727	12,102	182	1,794	741	5,105
1931 ..	2,373	12,456	182	1,794	850	5,390
1936 ..	2,795	13,325	168	1,775	784	6,049

II.—ESTIMATED AVERAGE YIELD PER TREE OF ORCHARD FRUIT (LB.)

	Cider Apples	Other Apples	Perry Pears	Other Pears	Cherries	Plums
1925 ..	47·6	60·3	11·1	5·1	52·8	17·6
1931 ..	35·3	14·2	11·8	15·0	35·1	13·4
1936 ..	76·8	52·9	113·1	35·2	46·9	44·2

Fruit Production—1936

III.—Estimated Production of Orchard Fruit (Thousand cwt.)

	Cider Apples	Other Apples	Perry Pears	Other Pears	Cherries	Plums
1925 ..	1,160	6,520	18	82	349	801
1931 ..	747	1,574	19	241	267	646
1936 ..	1,917	6,300	170	557	329	2,388

IV.—Acreage under Small Fruit (Thousands)

<table>
<tr><th></th><th>Straw-berries</th><th>Rasp-berries</th><th>Black-currants</th><th>Red and White currants</th><th>Goose-berries</th><th>Other Small Fruit</th><th>Total</th></tr>
<tr><td>1925 ..</td><td>27·7</td><td>7·0</td><td colspan="3">29·9</td><td>3·9</td><td>68·4</td></tr>
<tr><td>1931 ..</td><td>23·0</td><td>6·1</td><td>11·4</td><td>3·7</td><td>15·7</td><td>2·1</td><td>62·0</td></tr>
<tr><td>1936 ..</td><td>24·6</td><td>5·8</td><td>9·8</td><td>2·6</td><td>10·4</td><td>2·6</td><td>55·7</td></tr>
</table>

V.—Estimated Average Yield per Acre of Small Fruit (cwt.)

	Straw-berries	Rasp-berries	Black-currants	Red and White Currants	Goose-berries
1925 ..	24·0	20 0	16·0	17·0	36·0
1931 ..	29·1	24·7	20·3	22·9	43·5
1936 ..	14·8	14·4	13·2	9·8	24·4

VI.—Estimated Production of Small Fruit (Thousand cwt.)

	Straw-berries	Rasp-berries	Black-currants	Red and White Currants	Goose-berries
1925 ..	705	145	188	66	590
1931 ..	717	162	231	84	683
1936 ..	369	88	136	28	263

COOKING THE RARER VEGETABLES

AMBROSE HEATH

Every year I receive inquiries from readers of my books and newspaper articles about the cooking of those vegetables that are perhaps more uncommon than rare. It is not the vegetables themselves that are rare, but their growers. It is surprising that so many of what seem to be exotic growths can be produced quite easily in this country, and while there is a certain amount of risk and uncertainty in growing the kinds that need sunshine, there is little more than in growing tomatoes in the open. Bright and exciting-looking vegetables such as Aubergines (or Egg-Plants), Capsicums (those vivid shiny red, yellow and green objects like oversized gherkins that brighten our greengrocer's window in the summertime), curly Chinese artichokes, pearly corn-on-the-cob, black and pink potatoes—we can buy, we can even grow all these and many others, but how are we to discover the way to cook them? Here and there in the more recondite cookery books we may chance upon a stray recipe, and why, we ask, doesn't someone bring a few of them together?

I have drawn up a list of some twenty-four vegetables that appear, cooked, comparatively rarely on the dining-room table, and among them I have included one or two that are common enough uncooked, such as lettuce, chicory, endive and watercress though they are seldom seen cooked. The vegetables are these:—

Artichoke, Chinese.
,, Globe
Aubergine.
Beans, Waxpod.
Beet, Seakale
Capsicum (Sweet Peppers)
Cardoon.
Celeriac
Chick Pea.
Chicory.
Dandelion.
Endive.
Hop Tops.
Lettuce.
Maize (Sweet Corn).
Potato, Congo.
,, Fir Apple.
,, Sweet.
Salsify
Scorzonera.
Skirret.
Sorrel.
Sugar Pea.
Watercress.

It seemed best to list these in alphabetical order and deal with them in the same way, as thus they will be easier for reference than if they were dealt with in seasons. I have also added the French name as well as the Latin. One or two representative recipes are given for each, though for many there may be

others. They all make good eating, and I hope that they will not only be useful to readers who grow them, but will perhaps induce others to make the experiment.

Artichoke, Chinese (*Stachys tuberifera*: Fr. *Crosne*). These attractive little roots are decidedly preferable to their cousin (gastronomically) the Jerusalem artichoke. They are rather troublesome to prepare, the best way to do it being to cut off the threads from each end and then soak them for an hour or so in cold water. They can then be skinned by rubbing them in a cloth with some coarse salt, or they may be cooked first and skinned afterwards. In either event they are boiled for about twenty minutes in boiling salted water, drained and served with melted butter. By another method they can be blanched first for ten minutes in boiling water, then drained and cooked in butter until tender. A little cream is added just before they are ready, and allowed to thicken. By a third method they may be cooked as first directed, and, after being well drained, served with a cheese (*Mornay*) sauce poured over them. In my own opinion they are better quite plain, being specially good with lamb or mutton.

Artichokes, Globe (*Cynaria scolymus*: Fr. *Artichaut*). This is the true artichoke, seldom seen in England except when cooked whole and eaten with melted butter, the leaves being pulled off with the fingers and dipped in it. In France and other countries abroad, the greatest store is set by the artichoke bottom or *fond d'artichaut,* as it is called. This is the circular fleshy base that lies under the hairy part or "choke." The base parts are usually brushed over lightly with lemon juice as soon as they are cut out, and cooked slowly in very hot clarified butter. They should be turned over once, and should not be browned in the cooking. Served thus by themselves they make a delicious dish.

Aubergine or Egg-Plant (*Solanum esculentum*: Fr. *Aubergine*). These admirable vegetables should be better known outside London restaurants. There are two principal ways of cooking them, (1) sliced and fried, and (2) stuffed and baked. The two methods may be given as follows:—

(1) Peel them and cut them in thin slices across Put them on a dish, sprinkle them with salt, and leave them for half an hour covered with a cloth. Then dry them and having dipped them in batter, fry them golden in deep fat, and serve at once Good with grilled meat.

(2) Cut the aubergines in half lengthwise, but do not peel them. Make a few incisions on the cut sides and put them into a little smoking fat or olive oil, cut side downwards. After seven or eight minutes, take them up, drain them and scoop out the flesh with the handle of a spoon, to avoid piercing the skins which must be left intact. Chop up the flesh, mix it with a little cooked rice, chopped fried onion and tomato, and a little coarsely-minced cooked mutton (or the meat can be left out), fill the skins with this, sprinkle them with browned breadcrumbs and a few drops of olive oil, and brown them in the oven. A tomato sauce may be poured round them on serving if desired.

Beans, Waxpod (*Butter Beans*). If these beans are blanched in boiling water for about ten minutes, they can then be strung like French beans. They may then be cooked whole like French beans, and when cooked rolled in melted butter.

Beet, Seakale (Fr. *Bette*). This is a favourite vegetable in Switzerland, where it is often prepared as follows:—

Remove the leaves from the white fleshy midribs, trim the latter and cut them into four or five pieces Peel these like rhubarb with a sharp knife, and as they are done throw them into cold water. Drain them well and cook them in slightly salted boiling water for about three-quarters of an hour until soft to the touch Drain them again carefully and put them into a dish with alternate layers of thickish white or cheese sauce Sprinkle the top with breadcrumbs, and cheese too if liked, and brown quickly

Capsicum or Sweet Peppers (*Capsicum annuum*: Fr. *Piment or Poivron doux*). These are usually served stuffed, as follows:—

Cut off the tops of half a dozen sweet peppers, and scoop out the pips and pith from the inside, very carefully, so as not to damage the skins Chop up two onions with the tops of the peppers (after you have cut out the end of the stalk), and cook them in butter until nicely golden Then add salt, pepper, a teacupful of stock and two tablespoonfuls of tomato purée. Mix in a teacupful of well-drained half-cooked rice, and finish cooking it in this sauce. Add a little butter, strain the sauce from the mixture and use the latter to stuff the peppers. Put them into a buttered dish, pour the sauce over them, cover with buttered paper and cook them for about twenty minutes or so, basting with the sauce or some stock.

Cardoon (*Cynara cardunculus*: Fr. *Cardon*). Vegetables like the cardoon, salsify and scorzonera are best cooked in what the French call a *blanc*.

To make a *blanc* put a heaped tablespoonful of flour in a little water, and when it is quite smooth add two quarts of water, two tablespoonfuls of vinegar and a little salt. Stir until it boils, then add the vegetable and, finally, three tablespoonfuls of clarified beef or veal dripping. Then simmer. The fat forms a covering to keep out the air, the vegetables will cook gently underneath, and will keep their colour and flavour better. As for the cardoons, take off all the outer leaves and cut the inner ones in

pieces about four or five inches long. Peel them quickly with a sharp knife throwing them as soon as done into cold water with a spoonful of vinegar in it. Remove the hairy covering from the heart of the cardoon, and peel this also. Plunge the pieces into the boiling *blanc*, add the dripping as described above, cover and cook for about an hour and a quarter. Serve drained, with Hollandaise sauce, or *à la Mornay* with cheese sauce.

Celeriac (Fr. *Céleri-rave*). This may be peeled, cut in pieces and cooked in salted water or a *blanc* (see CARDOON) for about three-quarters of an hour. It is then drained and served with melted butter or with a cheese sauce.

Chick Pea (*Cicer arietinum*: Fr. *Pois chiche*). These, when dried, are much used in the South of France and in Spain where they are known as *garbanzos*. They can be cooked in the same way as dried peas, and are mostly used as an addition to stews and ragouts, and also as a salad, dressed when cold with a French dressing of two parts olive oil, one part vinegar, salt and pepper.

Chicory (*Cichorium intybus*: Fr. *Endive*). This long white plant is mostly used as a salad, but it is excellent when braised, but nicer still when cooked *à la flamande*:—

Take off the outside leaves of the chicory, and cut it up into rounds of about a finger's breadth Butter a shallow dish well (it should just be large enough to take the chicory), and put the chicory in, pressing it well down Put a piece of buttered paper on the dish and cover it closely. Add no liquid Cook in a slow oven for two hours, when all the liquid which has exuded from the chicory ought to have evaporated, leaving a cake of the vegetable, which, when you turn it out on a dish, will be found to be slightly golden Sprinkle it with a little salt and serve it.

Dandelion (*Leontodon taraxacum*: Fr. *Pissenlit*). The dandelion may be cooked as follows:—

Pick off the young leaves and wash them well, leaving them to soak for an hour in cold water. Blanch them for a minute or two in boiling salted water, then take them out and cook them in more boiling water for about half an hour. Drain them well, pressing out as much moisture as you can, then chop them up finely, cook them with a little butter, salt and pepper, and just before serving stir in a spoonful or two of cream

Endive (*Cichorium endivium*: Fr. *Chicorée frisée*). This makes a good hot vegetable dish.

Take off the outside and damaged leaves (you will probably have to sacrifice nearly half of each plant), cut the hearts in quarters and blanch them for a quarter of an hour in boiling salted water Drain them through a colander, plunge this at once into cold water, press as much moisture out as you can, chop them up finely, and finally wring them in a cloth. Make a white *roux* in a saucepan with butter and flour, add the endive

and mix well together. Now add a cupful or two of stock or milk, stir till it boils, season with salt, pepper and nutmeg and a pinch of sugar, cover with buttered paper, and then the lid and cook in a moderate oven for an hour. Stir in a few small pieces of butter before serving.

Hop Tops (Fr. *Jets de houblon*). These are much esteemed in Belgium, but not often met with in this country. They should be washed in several waters, then tied up in little bunches like asparagus, and cooked until tender in boiling water to which has been added a teaspoonful of lemon juice. They should be drained and served seasoned with salt and pepper, and bound with melted butter or cream.

Lettuce (*Lactuca sativa*: Fr. *Laitue*). Lettuces can be braised, but it gives less trouble to cook them in the following way, which is admirable with lamb or mutton. It is called *Laitues à l'etouffée*.

Cut two pounds of prepared lettuce leaves in strips of about a finger's breadth, and put a third of them into a heavy metal or an earthenware pan Have ready two ounces of butter Put a third of the lettuce in the pan and on it a third of the butter in little dabs Then add lettuce, butter, lettuce, butter, and on the top put four button onions, two lumps of sugar and a bouquet of parsley stalks, thyme and bayleaf tied together Do not add any liquid, but simply put on the lid very closely and simmer very gently for three-quarters of an hour to an hour There should then be about four tablespoonfuls of liquid in the bottom of the pan. Take the lettuce out, thicken this liquid with a little flour and butter, and pour it over the lettuce, from which you will already have removed the bouquet, though leave the onions if you like

Maize or Sweet Corn (*Zea Mays*: Fr. *Maïs*). The secret in cooking this is to see that there is no salt in the water, as this toughens it.

Remove the husks and silky threads, and cook the head in boiling unsalted water for ten to twenty minutes according to the size of the cob. Eat with melted butter Or, for corn oysters, you can grate off some raw corn from the cob, and mix a breakfastcupful of them with a beaten egg, salt, pepper and half a breakfastcupful of flour Drop by spoonfuls in hot deep fat and fry golden

Potatoes: *Congo* (*Black*) *and Fir Apple* (*Pink*). These look pretty in salads. They should both be cooked in their skins, and when done the skins can be rubbed off with a piece of flannel. They can of course be served hot if preferred.

Potato, Sweet (*Iporae batatas*: Fr. *Patate*). Sweet potatoes may be cooked in various ways, two of which are as follows:—

Scrub them well, rub them over with a little butter, and bake them in a fairly quick oven for about an hour. Serve like ordinary potatoes in

their jackets. An American fashion cooks them first, then mashes them and puts the purée into a buttered fireproof dish, roughening the surface with a fork. A teaspoonful of butter and two tablespoonfuls of molasses are then boiled together for five minutes, and this mixture is poured over the potatoes, which are baked in a hot oven until the top is brown.

Salsify (*Tragopogon porrifolius*: Fr. *Salsifis*). Nicely served salsify is by many people regarded as a very attractive dish.

Wash and scrape the roots quickly and throw them at once into a bowl of water to which vinegar or lemon has been added in the proportion of a tablespoonful to each quart of water. Leave them for half an hour, and then cut them into the lengths desired. Cook them either in boiling salted water with a squeeze of lemon, or better in a *blanc* (for this see under CARDOON). They will take about an hour, when you can take them out, drain them well and serve them covered with a white or an anchovy sauce; or they can be served in scallop shells, covered with the sauce, sprinkled with breadcrumbs and melted butter, and browned in the oven.

Scorzonera (*Scorzonera hispanica*: Fr. *Scorsonère*). This is prepared in the same way as salsify, except that it should be cooked in its skin and peeled afterwards.

Skirret (*Sium sisarum*: Fr. *Chervis*). These roots should first be treated like salsify, and no doubt they could be cooked in a *blanc*. (See CARDOON).

The more usual way is to put in a saucepan half a pint of water, a gill of milk, half an ounce of butter, two slices of lemon and a little salt, and as soon as this mixture boils to put in the skirret, and boil it for about an hour, not less Drain it well and serve it with melted butter or Hollandaise sauce; or cut it into lengths, put these in a fireproof dish, cover them with white sauce, sprinkle with grated cheese, dot with butter and brown quickly in the oven

Sorrel (*Rumex acetosa* : Fr. *Oseille*). Sorrel is most usually made into a purée in exactly the same way as spinach, but its astringent flavour is disliked by some people. It may, therefore, be mixed in various proportions (according to the palate of the eater) with spinach, and thus forms a very pleasant dish. Perhaps the favourite use for it in summer time is in a soup, which is exceedingly refreshing. For this the procedure may be as follows:—

Pick over the sorrel in the same way as spinach, and chop up coarsely half a pound of it Stew this slowly with a small piece of butter for twenty minutes, with the lid on the pan, then sprinkle in a good tablespoonful of flour, and let this brown lightly. Moisten with just over a quart of hot water, and season with salt and a pinch of sugar. Cover and boil gently for a quarter of an hour. Then beat two whole eggs in a teacupful of milk and mix this with the soup, pouring it in through a strainer and seeing that it does not boil again after the eggs are added.

Sugar Peas (Fr. *Pois gourmand; pois mangetout*). These should be picked very young as they are apt to get stringier as they get older.

Break off each end of the pea, and the strings should come off with the broken ends. Then break the pods in two or three pieces and cook them in any of the ways applicable to ordinary peas. The simplest is to put them into boiling salted water and cook them for about twenty minutes, serving them rolled in a little butter.

Watercress (*Nasturtium officinale*: Fr. *Cresson*). There are two dishes with watercress which must on no account be left out. The first is Watercress Soup.

Cook a pound of floury potatoes until they are about three-quarters done, then add a bunch of watercress, well washed and chopped. When the potatoes are done, rub them and the cress through a wire sieve and put this purée back into the saucepan with some water and cook a little longer without boiling. Season with salt and pepper, and finish with a little cream or with yolk of egg or both. Garnish with a few chopped watercress leaves and croutons of fried bread The consistence of the soup should be thickish-thin

Watercress Purée is the next, and to my mind far more delicious than either sorrel or spinach.

Pick and wash three-quarters of a pound of watercress, and cook it in plenty of boiling salted water for a quarter of an hour, with the lid off the pan. Let it cook fast all the time. Drain it in a colander and plunge it immediately into cold water. Drain it now as well as possible, pressing it between the hands, and chop it up finely, and if you like, rub it through a wire sieve. Now put it into a pan with an ounce of butter and stir it on a good heat so that it " dries " well. Season it now with salt and pepper, and perhaps a tiny grating of nutmeg, sprinkle it with a scant dessert-spoonful of flour and mix well together. Now add three tablespoonfuls of stock and the same of milk (or all milk if preferred), stir until it comes to the boil, then cover and simmer gently for half an hour. When it is served, stir in a few small pieces of butter

Good King Henry (*Chenopodium bonus Henricus*). I have been reminded to add a recipe for this vegetable, which is found in some parts of England.

Cut the young shoots, tie them in bunches and cook them like asparagus Well wash the leaves and blanch them in a little water for a quarter of an hour. Then add a little salt, and boil for another five minutes. Drain it then and chop it finely. Melt a little butter in a pan, add very little flour, and season with salt and pepper, put in the vegetables and cook for another five minutes.

MARKETING NOTES

Milk Marketing Scheme. The wholesale price for liquid milk (other than Tuberculin Tested milk) in February, 1938, was 1*s*. 6*d*. per gal., the same as in the previous month, but a 1*d*. more than in February, 1937. The wholesale price for Tuberculin Tested milk in February, 1938, was 1*s*. 8*d*. per gal., the same as in the previous month.

Pool prices for February, 1938, are given below, with comparative figures for January, 1938, and February, 1937.

	Pool Prices		
	Feb 1938 *d*	*Jan* 1938 *d*	*Feb* 1937 *d*
Northern	15	15¼	14
North-Western	15	15¼	14
Eastern	15½	15¼	14¼
East Midland	15½	15½	14¼
West Midland	14¾	15	13¾
North Wales	15	15	13¾
South Wales	15	15¼	14
Southern .	15½	15¾	14½
Mid-Western	14¾	15	13¾
Far-Western	15	15	13¾
South-Eastern	15¾	16	14¼
Unweighted Average	15·16	15·34	14·07

These prices are exclusive of any premium for special services and level deliveries, and also of the quality bonuses for Accredited and Tuberculin Tested milks. The estimated gallonage on which quality premiums have been earned was 30,453,336.

The inter-regional compensation levy was fixed at 1¼*d*. per gal., compared with 1½*d*. per gal. in February, 1937. Sales on wholesale contracts were as follows:—

	Feb, 1938 (*estimated*) *Gal*	*Feb*, 1937 (*estimated*) *Gal*
Liquid .	48,104,245	45,024,857
Manufacturing	14,463,846	14,976,520
	62,568,091	60,001,377
Percentage liquid sales . .	76·88	75·04
Percentage manufacturing sales .	23·12	24·96

The average realization price of manufacturing milk during February was 7.59*d*. per gal. compared with 6.26*d*. per gal. for February, 1937. The quantity of milk manufactured into cheese on farms was 605,320 gal. compared with 593,753 gal. in the previous month and 342,674 gal. in February, 1937.

Manufacturing Milk Prices. The Milk Marketing Board, after agreement with the Central Milk Distributive Committee, have prescribed that the price of milk delivered in January, February and March, 1938, and used in the manufacture of cheese (other than soft curd cheese, cream cheese, Stilton cheese and blue vein cheese), and in the manufacture of condensed milk for export, shall be increased by 1*d.* per gal.

The question of an increase in the price of milk for cheese in the summer months is being considered by the Milk Marketing Board and the Central Milk Distributive Committee.

The Milk Marketing Scheme, 1933. The Milk Marketing Scheme, 1933, which has been amended on three occasions, has, for convenience of reference, been reprinted in its amended form. Copies of the amended Scheme may be obtained price 1*s.* net from His Majesty's Stationery Office or through any bookseller.

Report for 1937 of the Food Council. The Food Council have made a report* to the President of the Board of Trade reviewing the position in regard to the principal foodstuffs during the year 1937. The report also deals with matters that have come under the Council's consideration in the capacity of Consumers' Committees.

Pigs Marketing Board. *Co-opted Members.* The Pigs Marketing Board (after consultation with the Market Supply Committee as required by statute) have re-appointed Sir Arnold Gridley, K.B.E., M.I.E.E., M.P., and Mr. E. T. Thornton-Smith as co-opted members of the Board for a term of two years from January 31, 1938.

Annual Elections, 1938. At the election held on February 26, 1938, Mr. J. M. Eady, the sitting member, was returned to the Board as Member for the East Midland District.

Hops Marketing Scheme. *Inquiry into Quota Provisions.* The Minister has decided that the inquiry into the quota provisions of the Scheme, for which purpose a non-statutory Committee of three members was recently appointed (see this JOURNAL for February, 1938, p. 1101), would be facilitated if it were conducted by a statutory body. The Committee has accordingly been reconstituted, with similar terms of reference,

* His Majesty's Stationery Office, Price 9*d.*

as a Reorganization Commission under the provisions of the Agricultural Marketing Acts, 1931 to 1933. Two additional members were necessary, and the Commission has been constituted as follows: Mr. A. W. Cockburn (Chairman), Mr. A. F. Forbes, Mr. T. W. Haward (members of the original Committee), Mr. C. J. T. B. Grylls and Mr. R. D. Peck. The Secretary is Mr. R. G. R. Wall, of the Ministry of Agriculture and Fisheries.

Potato Marketing Scheme: *Submission of Amendments.* The Potato Marketing Board have duly submitted to the Minister of Agriculture and Fisheries and the Secretary of State for Scotland certain amendments of the Potato Marketing Scheme, 1933.

Copies of the amendments may be obtained on payment of 6*d*. per copy (post free) from the Potato Marketing Board, Africa House, Kingsway, London, W.C.2, on application to the Secretary (E. C. Boughton, Esq.); or may be inspected on personal application at the above-mentioned address or at the Office of the Board in Scotland, 53, York Place, Perth, between 10 a.m. and 4 p.m. on weekdays other than Saturdays, Good Friday and any Bank Holiday.

Any objections or representations with respect to the said amendments should be made to the Minister of Agriculture and Fisheries and the Secretary of State for Scotland and addressed to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1, the Under-Secretary of State for Scotland, Scottish Office, Whitehall, London, S.W.1, or the Secretary, Department of Agriculture for Scotland, 29, St. Andrew Square, Edinburgh, so as to reach them not later than May 7, 1938. Every objection must be made in writing and must state the grounds of objection and the specific modification required.

Bacon Marketing Board. *Annual Elections,* 1938. At the annual elections of members of the Bacon Marketing Board by registered curers in Great Britain, all the sitting members were re-elected with the exception of Mr. T. Hollingsworth, who was a member of the small curer class. In this class Mr. A. E. Howlett is the new member.

Milk Acts, 1934 to 1937. *Manufacturing Milk.* Payments made by the Ministry in respect of milk used during the period

April, 1934, to September, 1937, for manufacture into certain milk products were as follows:—

Section of Act		Quantity (Gal.)	Payments (£)
(A)	MILK MARKETING BOARD FOR ENGLAND AND WALES:		
	In respect of milk:—		
1	Manufactured at factories other than the Board's	535,154,315	2,260,673
2	Manufactured by the Board ..	10,157,541	36,681*
3	Made into cheese on farms	46,140,813	198,055
	Total for England and Wales ..	591,452,669	2,495,409
(B)	GOVERNMENT OF NORTHERN IRELAND:—		
	In respect of milk:—		
6	Manufactured into cream and butter at registered creameries ..	82,139,788	419,170
	TOTAL	673,592,457	2,914,579

* Manufacturing period to March, 1937.

Wheat Act, 1932: *Sales of Home-Grown Wheat—Cereal Year* 1937-38. Certificates lodged with the Wheat Commission by registered growers during the period August 1, 1937, to March 4, 1938, cover sales of 16,493,873½ cwt. of millable wheat as compared with 15,488,859½ cwt. in the corresponding period (to March 5) of last year.

New Quota Payments Order. After consultation with the Wheat Commission, the Minister of Agriculture and Fisheries has made the Wheat (Quota Payments) No. 2 Order, 1938, (S.R. & O., 1938, No. 170). This Order, which came into force on March 13, alters the rate of the quota payment, which millers and importers of flour are liable to make to the Wheat Commission on each hundredweight of their output of flour, from 4.8*d.* to 7.2*d.*, that is, from 1*s.* to 1*s.* 6*d.* per sack of 280 lb.

Sugar Industry (Reorganization) Act, 1936. *Supplementary Payments for Poor Crops.* The Minister of Agriculture and Fisheries, with the consent of the Treasury, has made rules relating to supplementary payments in respect of poverty of the crop of home-grown beet in any year (S.R. & O., 1938, No. 107).

The Minister, after consultation with the Sugar Commission, has made a supplementary payment of £141,239 in respect of poverty of the crop of home-grown beet in 1937 due to adverse farming conditions, this payment being of the maximum amount payable under the Act, namely 1*s*. per ton of beet of 15½ per cent. sugar content and a corresponding figure per ton of beet of higher or lower sugar content. The British Sugar Corporation is distributing this sum amongst growers in accordance with the requirements of the Act at a rate of 6½*d*. for every £ payable to growers for beet of the 1937 crop under their contracts.

Incentive Agreement and Rate of Assistance Order. The Minister of Agriculture and Fisheries, after consultation with the Sugar Commission and with the consent of the Treasury, has entered into an Agreement with the British Sugar Corporation under Section 14 (4) of the Act providing for the inclusion in the prescribed rate of assistance of a sum per cwt. to represent a proportion of the economies achieved by the Corporation. This Agreement is designed to give the Corporation an incentive to achieve all practicable economies and to attain the highest practicable standard of efficiency in its business. The Agreement implements a recommendation of the Sugar Tribunal published in the White Paper on the "Amalgamation of the Beet Sugar Manufacturing Companies" (Cmd. 5139, price 3*d*. net), the provisions of which were summarized in an article in the issue of this JOURNAL for May, 1936 (p. 141). The Agreement will shortly be published by H.M. Stationery Office.

The Minister has also made the Sugar (Rate of Assistance) No. 1 Order, 1938, prescribing for 1937 a rate of assistance of 2*s*. 7·7*d*. together with such additional sum as may be determined under the Incentive Agreement to represent the share of economies to be retained by the Corporation for 1937. This rate is related to an estimated average raw sugar price of 6*s*. per cwt. and an estimated maximum quota income of £984,789. The Order also fixes the minimum sum to be placed by the Corporation to a depreciation reserve in 1937 as £210,000.

As the amount of sugar produced by the Corporation from home-grown beet of the 1937 crop falls short of the standard quantity of 560,000 tons of white sugar by over 15 per cent., the rate of assistance will be increased by 2*d*. a cwt. in accordance with the Act.

Livestock Industry Act, 1937. *Cattle Fund.* The following table gives particulars of payments made out of the fund set up under the Cattle Industry (Emergency Provisions) Acts, 1934 to 1936, and the Livestock Industry Act, 1937:—

Period	*Payments*	*Animals*	*Average Payment per Animal*		
	£		£	s.	d.
April, 1935, to February, 1936 ..	3,519,323	1,483,789	2	7	5
" 1936 " " 1937 ..	3,632,792	1,544,342	2	7	1
" 1937 " " 1938* ..	3,551,558	1,440,222	2	9	4
From commencement of subsidy to payments to February 28, 1938 ..	13,431,060	5,607,827	2	7	11

* The payments during this period comprised £1,357,688 for 581,630 animals certified under the Emergency Provisions Acts, and £1,243,062 for 386,630 animals of quality standard, and £950,808 for 471,962 animals of ordinary standard certified under the 1937 Act

Egg Marketing. In reply to questions in the House of Commons on February 14, the Minister of Agriculture and Fisheries made the following statement:—

"As the hon. Members will be aware, the proposals of the Poultry Technical Committee, which have now been published, provide for the setting up of a Stock Improvement Commission with functions of control in regard, among other things, to the distribution of breeding stock, hatching eggs, and day-old chicks and to a grading scheme for breeding farms. The marketing proposals to which the hon. Member refers, provide, for their part, for the setting up of a producers' marketing board to regulate certain distributive functions, with special reference to the standardization of grading and packing of commercial egg supplies. In inviting the bodies representative of the industry to acquaint me with their views on the report of the Technical Committee, I am asking them to reconsider their marketing proposals, in order to see whether the results which they and the Committee desire could not be achieved with economy and efficiency through a single organization. I am also inviting the bodies representing distributors to consider this question from their point of view."

Consultations are taking place accordingly.

Regulation of Imports of Processed Milks. Imports of processed milks during the year 1937, together with the allocations made to foreign exporting countries and to Eire

for the same year, and imports from other Empire countries in the two previous years, are shown in the following table:—

Source	Condensed Skimmed Milk (cwt.)	Condensed Whole Milk (cwt.)	Milk Powder (cwt.)	Cream (cwt.)
FOREIGN COUNTRIES —				
Allocations . ..	1,185,900	211,100	70,000	34,300
Imports . . .	1,161,900	218,000	123,900	35,800
EIRE —				
Allocations .	84,000	21,600	350	37,200
Imports .. .	79,900	25,600	7,370	39,000
OTHER EMPIRE COUNTRIES				
Imports, 1935	—	128,800	172,200	—
Imports, 1936 .. .	—	97,600	173,300	200
Imports, 1937	—	198,900	161,600	1,000

As a result of discussions held with the representatives of the principal foreign supplying countries, arrangements have been made for reducing exports of processed milks to this country to a level that should enable United Kingdom manufacturers to secure a satisfactory share of the home market. At the same time the foreign exporters and home manufacturers concerned have concluded agreements governing the marketing of the chief descriptions of processed milks in this country.

In these circumstances it has been decided not to give effect to the recommendations of the Import Duties Advisory Committee* for increased duties on processed milks, as long as the voluntary arrangements for the limitation of exports to the United Kingdom and the marketing arrangements between exporters and manufacturers continue to operate satisfactorily.

National Mark Publicity. A National Mark exhibit will be staged at the Grocers' and Allied Trades' Exhibition to be held at Belle Vue, Manchester, from April 26 to May 7. A comprehensive range of National Mark products, including cheese, eggs, cider and perry, fresh, bottled and canned fruit and vegetables, flour, wheat flakes, honey, and fruit juice products, will be displayed. Samples of National Mark produce will be on sale, together with a selection from the Ministry's publications.

The Ministry is offering prizes for a competition to be held on four days at the Exhibition in the dismantling and re-dressing of a shop window with National Mark products.

* Cmd 5,591 (obtainable from H.M. Stationery Office, price 1*d*. net)

APRIL ON THE FARM

R. W. Wheldon, D.Sc.,
King's College, Newcastle-upon-Tyne

In most seasons April is the month when plants first show signs of vigorous growth, but the present season can scarcely be regarded as normal. Up to the time of writing (mid-March) weather conditions have been unusually mild, and pastures are green with young grass, while wheat on favourable soil has made considerable growth. Spring work is well forward. On many farms spring corn is all sown and a considerable acreage of potatoes has been planted.

The difference in the progress of spring work on various farms is very marked. Some farmers who work by the calendar for seed sowing have no spring corn sown, while their neighbours have finished. In the north of England the present season is regarded by older farmers as one of the most forward for very many years. On March 5 the lower branches of the hawthorn hedges common in the north of England were in leaf, while the elm and blue moor grass (*Sesleria coerulea*) were in flower. This is probably a month earlier than usual.

It will be interesting to see what is gained by this earliness. Very soon rain will be needed, if it is not so already. Heavy rainfall on newly-tilled land may put it seriously out of condition, and, as seeds are already sown, this cannot well be remedied, while a spell of very cold weather with frost may check the growth that has been made during the past mild spell.

Pasture Land. Much has been written on the manuring of pastures, but it must be borne in mind that grazing management plays a most important part in determining the returns obtained for the manures applied.

As distinct from annuals such as cereals and other arable crops, pasture plants are to produce a crop year after year, and for this reason management must be designed to maintain the plant in vigour after a season's output. Good root development is necessary if a high output of herbage is to be obtained. This good root development is dependent on a large leaf system, hence continuous heavy

grazing and consequent defoliation of the pasture plants results in restricted and limited root development.

In general, pastures have been very closely eaten during the winter, while the mild weather has encouraged farmers to turn out stock more than usual, so that any spring growth has been consumed as fast as it came. Even if pasturage is short, a rotational system of grazing to allow for a brief rest and some uninterrupted growth may be well worth while where the practice can be carried out. Most pastures are very dry at present and have suffered comparatively little from poaching by outlying stock during the winter. Should heavy rain occur and pastures become sodden every effort should be made to move outlying stock to the drier land, so as to avoid poaching at this season of the year. Severe poaching now would almost certainly result in greatly reduced growth of the pasture during the remainder of the year.

Cereals. The acreage for both winter- and spring-sown wheat is greater than that of last year. Although the crop may look well owing to the recent favourable weather, it will pay for manurial and cultural treatment should this be needed. If nitrogen is required the application should not be delayed too long. Numerous experiments have been carried out to ascertain the best time to apply nitrogen to the wheat crop. The results indicate that where there is a thin, weak plant in spring, early applications are desirable to help the crop over a critical period and encourage it to fill out. On sour soil nitrate of lime, or nitro-chalk would be likely to give the best results, although costing rather more per unit of nitrogen than sulphate of ammonia. Where the crop is thick and vigorous in spring, application may be delayed until late April.

Harrowing of wheat in dry weather is a great help as it provides a surface mulch very valuable to the plant. The harrowing should not be delayed as it aids tillering, and it is advantageous if this takes place before the leading shoots have made too much progress.

The practice of horse-hoeing spring-sown cereals has much to commend it. Not only does it improve soil conditions and assist in conserving moisture, but it destroys weeds and also encourages weed seeds to germinate, the young plants so produced being afterwards overshadowed and frequently killed by the more forward cereal. Cleaning foul land is often a very

expensive item involving much labour. As labour is a difficulty on many farms at the present time any inexpensive operation that may help in keeping the land clean is worth while.

Live Stock. During the month lambing takes place on the hill farms of Scotland and the north of England. The ewes have had a period of good weather and should be in good condition for lambing. Bad weather during the lambing period can account, as it did on many farms last year, for a high percentage of losses. At the moment of writing the prospects for hill lambing are good.

As dairy cows get more young grass it is advisable to reduce the amount of protein fed in the ration. Flaked maize or crushed oats are carbohydrate foods that are suitable for use when the cows are getting a limited quantity of fresh young grass. Although the cost of these foods at the present time is high, and little saving may be effected by substituting them, it is a disadvantage to the animal to receive too large an amount of protein. As the amount of pasturage increases the concentrates should be cut down. It is usually more economical to save on concentrates in April, May and June than at any other season of the year, provided sufficient pasture is available.

Most owners of cattle—beef producers as well as dairy farmers—must have given some consideration to the assistance now available for the reduction of the amount of disease, particularly tuberculosis. Healthy herds are more efficient producers than those that are diseased, and while some expense is invariably necessary before a free herd is obtained, the assistance now available is of great value. The question of segregating healthy stock from diseased is a problem on most farms. The risk of infection is probably less when animals are at grass, and if it is possible to pasture the healthy and affected animals on different fields, the present time is a most suitable one to make a start in the establishment of a tubercle-free herd.

Contagious abortion, another troublesome disease, is controllable. Some farmers prefer to deal with one disease at a time, but where possible it is certainly advisable to attempt both. It is most discouraging to find contagious abortion spreading in a tubercle-free herd. Purchased animals (and it is usually necessary to purchase some animals in cleaning up

a herd) if from free herds would be likely to contract the disease and in all probability abort—hence the desirability of introducing them to a safe herd.

General. The introduction of the sugar-beet has made April an important month for the root break. In the Midlands and South the sowing of the root break normally took place in May and June. During the comparatively short period that sugar-beet has been grown, it is remarkable what progress has been made in handling the crop. The most suitable soil conditions, manuring, time of sowing, singling, etc., have all been studied, and a high standard of production has been attained. The sugar-beet crop affords an excellent example of the gain secured by attention to each operation. Farmers probably take more account of the conditions affecting the sugar-beet crop than any other, as the whole crop is weighed off and the results determined. With other root crops, grown for stock feeding, we frequently do not know to a few tons per acre what returns we are obtaining. It may be worth while asking ourselves the question " Are we getting the returns we should from root crops grown for stock? " and if not, " What are the reasons."

In the north of England the system of " hiring " farm workers still persists. Married men are usually engaged for a year, and single men for six months. May 13 is " flitting " day in Northumberland and Durham. At different market towns, recognized days are set aside for hiring or engaging men. Years ago these days were important and the markets were full of employers and employees. Nowadays by far the majority of engagements take place before the fixed hiring day, and the hiring market is little more than a shadow of the past. Mechanization on many farms has reduced the number of permanent employees and increased the need for casual or seasonal labour. The effect of this may be that many important classes of work, such as hedging and ditching, are neglected. When a full staff of men was regularly employed on the farm such work got done, and although it is perhaps difficult to assess its value in £ *s.* *d.* it is none the less important.

NOTES ON MANURING

F. Hanley, M.A.,

School of Agriculture, Cambridge

Nitrogen and Organic Matter in Grass Land. In the January, 1938, issue of the *Journal of Agricultural Science* Dr. H. L. Richardson describes investigations carried out at Rothamsted into the nitrogen cycle in grassland soils. His results and conclusions not only throw fresh light on our knowledge of grassland nitrogen but also have a direct bearing on other aspects of grassland management. The amounts of ammonia and nitrate nitrogen present in fresh soil from grass land at Rothamsted were very small, but fairly constant. For each type of nitrogen an equilibrium level was found representing a balance between rate of production and rate of removal. The amount of ammonia nitrogen present was consistently greater than the amount of nitrate nitrogen—a state of affairs directly contrary to that usually found in arable soils. This was true for a temporary ley as well as for old permanent grass land.

Nitrogen added as nitrate of soda or sulphate of ammonia disappeared with surprising rapidity, half the amount added disappearing within a few days in late spring or about one or two weeks in winter. The fact that ammonia, applied as sulphate of ammonia, disappeared rapidly, even on plots where nitrification was poor, led to the suggestion that ammonia was being taken up directly by the herbage. This was confirmed by the fact that ammonia, applied as sulphate of ammonia, did not disappear from soil from which the herbage had been previously removed and herbage roots severed just below the surface of the ground, though it disappeared almost completely from adjacent areas where the herbage was left growing. This uptake of nitrogen as ammonia seems to be true for temporary leys as well as old grass land, and is probably extensive in acid soils where nitrification is poor.

In the examination of soils from differently manured plots the effect of lime on the decomposition of organic matter was found to be very variable. On unmanured plots, and plots manured with organic matter, the addition of lime seemed

to accelerate the decomposition of organic matter, but on plots receiving mineral fertilizers the soil on the limed portions had a higher content of organic matter than corresponding unlimed portions.

On the unlimed " sulphate of ammonia plus minerals " plot a " mat " of partly decomposed herbage was present, as is so often found on very sour grass land. In the past, the formation of such a " mat " has usually been put down to the intense acidity of the soil retarding the decay of the organic matter. Dr. Richardson points out, however, that when the " mat " of organic matter was mixed with the underlying soil in the laboratory, the organic matter decomposed rapidly on incubation, without any addition of lime, and hence the primary cause of " mat " formation may simply be the complete absence of earthworms. Earthworms are apparently repelled in some way by soil acidity and absence of worms has been previously noted as characteristic of acid " matted " grass land. In their absence dead herbage is not dragged down into the soil and so does not decompose, though it does so readily when it is mixed with the soil.

This conclusion emphasizes the importance of breaking up the " mat " and mixing it with the soil in the reclamation of " matted " grass land, the process of decay and rotting being then further accelerated by the application of lime and fertilizer. It is common experience that lime works more slowly on grass than arable land, and it may be several years before any marked response is visible on a " matted " turf that is really acid. If, however, " matted " grass land is ploughed out and then limed, the lime produces its effect much more quickly. If the land is kept under arable crops for a year or two the cultivations for those crops promote a more rapid decay than if the ploughed-out grass is immediately re-seeded. Some people, on the other hand, prefer to break up a " mat " with heavy rotary harrows and then get rid of it by burning, either as it lies on the field or after collecting into heaps. Some such method may have advantages where ploughing is to be followed by immediate re-seeding, but must necessarily be very wasteful of organic matter.

Where ploughing is not contemplated, vigorous cultivation with harrows of suitable type and weight should be done to open up the turf as much as possible, and thereby encourage natural decomposition of the accumulated organic matter by facilitating its admixture with the soil.

Legumes as Nitrogen Providers. The presence of nodules on the roots of clovers and other legumes has attracted attention from very early times. The beneficial effect of a good clover ley on the succeeding crop, and the similar advantage gained by crops following peas or beans, have played a considerable part in the development of cropping rotations. Not only are the legume crops themselves rich in nitrogen but they leave behind them considerable stores of nitrogen in the soil.

The discovery of the part played by the root nodules in this story, and particularly the fixation of nitrogen from the air by the root nodule organisms, was a great advance. The recognition of the fact that there are several different strains of nodule bacteria, each of which can infect only a limited number of legume species and fail to produce satisfactory nodules on other legumes, has made it possible to grow good crops of say, lucerne, in a new district, by simply inoculating the seed with the right strain of nodule bacteria, now obtainable in commerce. A farmer can thus ensure satisfactory growth and good nodule development in a crop growing in soil that has never previously grown that species of legume. The essential point is to ensure the presence of the right strain of nodule organisms and to make soil conditions favourable to their activity, for which a sufficiency of phosphate is especially important.

Considerable advance has recently been made in our knowledge of the effect of nitrogenous fertilizers on clovers and the effect of legumes on plants growing in close proximity to them. The effect of nitrogenous fertilizer on clovers is important in any consideration of grassland management. Investigation has shown that nodule formation on legumes may be harmfully affected by the addition of nitrates or ammonium salts, both number and size of the nodules being reduced. When a legume is grown alone, however, the addition of mineral nitrogen does not necessarily reduce its growth but simply tends to replace the nitrogen that would be otherwise obtained from the nodules. In other words the legume may grow just as well with either source of nitrogen. Although it is obviously undesirable and uneconomical to spend money on added nitrogen if this is to reduce the fixation of free nitrogen by the nodule bacteria, it is not necessarily harmful to the actual growth of the clover.

When mineral nitrogen is added to a mixed herbage of grass

and clover, however, the result is very different—the clover is usually depressed and may even disappear altogether. It seems that this fact, however, must be largely attributed to the direct competition of the grass when supplied with added nitrogen. Hence, though artificial nitrogenous fertilizers may be extremely useful for special purposes, such as the production of an early bite, too heavy or too frequent applications may upset the balance of species in the sward unless appropriate steps are taken to counteract any such tendency. It seems generally more economical therefore to rely as far as possible on the nodule bacteria to supply the nitrogen for permanent grass land, and hence the importance of phosphate on grass land, for phosphate stimulates nodule development.

The effect of legumes on plants growing in close proximity to them has attracted far less attention than the earlier discovery of the part played by the nodule bacteria in the life of the legume itself and in increasing the nitrogen reserves in the soil for succeeding crops. Virtanen and his colleagues in Finland observed that when inoculated red clover was grown alone in sand, appreciable nitrogenous material could be found in the sand, even at a very early stage of growth. Further experiments have now convinced Virtanen* that "nitrogenous compounds are excreted into the soil from legume nodules and this excretion commences immediately upon the formation of the nodules. The excreted nitrogen compounds are products of the nitrogen fixation and not decomposition products of proteins." By the use of special nitrogen-free, sterile cultures Virtanen has shown that some non-legumes will grow quite well on the nitrogen compounds excreted by the nodules of certain legumes growing alongside them. Hence legumes may be beneficial not only because of their own high protein content but also because their nodule activity results in the excretion of combined nitrogen into the soil from a very early stage in their growth, and much of this can apparently be taken up by suitable non-legumes growing in close proximity to them. The view that legumes enrich the nitrogen reserves in the soil only through the residual value of nitrogen compounds released when their roots decay is therefore no longer tenable.

Recent work at Rothamsted on lucerne and grass grown in sand cultures seems to confirm Virtanen's general result.

* Report of Fourth International Grassland Congress, 1937, p. 86.

It must be admitted that the principle of the excretion of fixed nitrogen from the root nodules of legumes is not yet universally accepted, and certainly not for all types of legumes, since some investigators claim to have been unable to find evidence of excretion from the nodules of certain species. Nevertheless it has been shown that in some way certain legumes can obtain from the air sufficient nitrogen both for their own needs and those of a non-legume growing beside them.

Much of the experimental work has been done in pot cultures, and it is still not clear how important this action may be under field conditions. Further investigations must be made into the exact nature of the nitrogenous excretions, the conditions that influence the rate of excretion and the non-legumes and legumes best suited to one another. Virtanen states that the excretions are mainly amino-acids, and though all non-legumes cannot use the various amino-acids equally well, this is probably of little importance in practical farming since the soil contains numerous micro-organisms that will split off ammonia from amino-acids and thus render the nitrogen available to non-legumes. Again, the extent of excretion is generally higher in cultures of legume and non-legume than in cultures of the legume alone, but if too large a proportion of non-legumes is present the growth of the legumes is affected and both suffer. In Finnish experiments* the growth of both legume and non-legume suffered when the ration of non-legumes to legumes exceeded about 2 : 1.

It seems, therefore, that with further elucidation of the correct conditions it may be possible to speed up the activity of the nodules of our legumes, and, by associating them with suitable non-legumes, make them serve as more efficient nitrogen providers to the non-legumes, both in permanent grass land and in one-year associations such as oats and peas, oats and tares and one-year " seeds." Looking at the matter from another standpoint, there may be unnecessary loss of nitrogen if legumes are grown alone, for the excreted nitrogen may decompose in the soil and be washed away if a non-legume is not present to take up the excreted nitrogen.

One further point of importance is that the amount of excretion depends on the bacterial strain used for inoculation. Virtanen states that there are strains that fix nitrogen abun-

* Summarized by H. Nicol in *Internat. Rev. Agric*, 1936, 2, T, 201–215

dantly, providing the legume with adequate nitrogen but excreting only very little nitrogen, whilst others fulfil both functions. This is further complicated by the discovery that some strains of nodule organisms, whilst forming numerous nodules, supply only very small amounts of nitrogen to their legume host plant. This again points to the importance of the strain of nodule bacteria, and the discovery of more efficient strains, leading to an even greater use of the nitrogen-fixing powers of leguminous crops, may not be out of the question.

PRICES OF ARTIFICIAL MANURES

Description	Average prices per ton (2,240 lb) during week ended March 9.				
	Bristol	Hull	L'pool	London	Costs per Unit¶
	£ s	£ s	£ s.	£ s	s d.
Nitrate of Soda (N. 15½%) .. *	8 0c	8 0c	8 0c	8 0c	10 4
,, ,, Granulated (N 16%) *	8 0c	8 0c	8 0c	8 0c	10 0
Nitrate of Lime (N. 13%) .. *	7 7e	7 7e	7 7e	7 7e	11 4
Nitro-Chalk (N 15½%) .. .. *	7 10c	7 10c	7 10c	7 10c	9 9
Sulphate of Ammonia :— Neutral (N. 20·6%) .. .. *	7 14c	7 14c	7 14c	7 14c	7 6
Calcium Cyanamide (N. 20·6%) *	7 15d	7 15d	7 15d	7 15d	7 6
Kainite (Pot 14%) .. .. §	2 18	2 15	2 15	2 15	3 11
Potash Salts (Pot 30%) .. §	5 4	5 1	5 0	5 1	3 5
,, ,, (Pot. 20%) .. §	3 15	3 12	3 12	3 12	3 7
Muriate of Potash (Pot 50%).. §	8 10	8 8	8 5	8 8	3 4
Sulphate ,, (Pot. 48%).. §	10 2	10 0	9 17	10 0	4 2
Basic Slag (P A 15¾%).. .. §	2 12b	2 5b	..	2 10b	3 2
,, ,, (P A 14%) .. .. §	2 8b	2 0b	2 0b	2 6b	3 3
Grd Rock Phosphate (P.A 26–27½%) .. .. .. §	3 7a	3 2a	2 18a	2 12a	2 0
Superphosphate (S P A 16%).. §	3 4	..	3 5f	3 2g	3 11
,, (S P A. 13¾%).. §	3 1	2 17	3 2f	2 19g	4 3
Bone Meal (N. 3¾%, P A 20½%) §	..	7 5	7 5h	7 0	..
Steamed Bone Flour (N ¾%), P A. 27½–29¾%) .. .. §	5 5i	5 5	4 15h	4 11	..

Abbreviations. N = Nitrogen, P A = Phosphoric Acid; S P A. = Soluble Phosphoric Acid, Pot = Potash

* Prices are for not less than 6-ton lots, at purchaser's nearest railway station, unless otherwise stated. Unit values are calculated on carriage-paid prices

§ Prices are for not less than 2-ton lots, nett cash for prompt delivery f o r. in town named, unless otherwise stated Unit values are calculated on f o.r. prices.

a Prices for 4-ton lots f.o r. Fineness 85% through standard sieve

b Prices for 6-ton lots Prices at Bristol are f o r Bridgwater, at Hull and Liverpool f.o r neighbouring works, and at London f o r. at depots in London district Fineness 80% through standard sieve.

c For lots of 4 tons and under 6 tons the price is 1*s* per ton extra, for lots of 2 tons and under 4 tons, 5*s*. per ton extra, and for lots of 1 ton and under 2 tons, 10*s* extra.

d Delivered in 5-ton lots at purchaser's nearest railway station. For lots of 2 tons and under 5 tons the price is 5*s* per ton extra, for lots of 1 ton and under 2 tons, 10*s*. per ton extra, and for lots of 4 cwt. and under 1 ton, 20*s* extra.

e For lots of 4 tons and under 6 tons the price is 1*s* per ton extra, for lots of 2 tons and under 4 tons, 5*s*. per ton extra, for lots of 1 ton and under 2 tons 7*s* 6*d*. per ton extra, and for lots of under 1 ton, 20*s*. extra

f Prices shown are f.o r. Widnes.

g Prices shown are ex works London ; f o r southern rails, 1*s*. 3*d* extra.

h Prices shown are f o r. Appley Bridge

i Price shown is f.o.r Newport, Mon.

¶ *These are calculated by regarding a ton as comprising* 100 " *units* " (*equal parts of* 22·4 *lb.*) *so that a fertilizer, for example, with* 16 *per cent. nitrogen, contains* 16 *such* " *units* " *in a ton. Then, if the price per ton of such a fertilizer be divided by the percentage figure, the deduced cost is that of a* " *unit* " *of that agent Those in the table above are based on London prices.* (*For further explanation, see Advisory Leaflet No.* 146, " *The Valuation of Artificial Manures* " *obtainable from the Ministry, free of charge.*)

NOTES ON FEEDING

CHARLES CROWTHER, M.A., Ph.D.,
Harper Adams Agricultural College

The Protein Requirements of the Milch Cow. The importance of securing economy with efficiency in the rationing of the dairy cow needs no argument at the present time. The cow must receive just what she needs, but no more, especially of such an expensive food ingredient as protein. The practical difficulty is to assess what is this minimum quantity that will just cover her special needs for protein. It is not a fixed quantity remaining constant under all the varied conditions of milk production. The requirement of digestible true protein for maintenance (per 1,000 lb. live weight per day) may under certain conditions fall as low as 0.3 lb. and under other conditions rise as high as 0.6 lb. The extra amount of protein required to cover the production of a gallon of milk of average quality may show a similar range.

Under the conditions that prevail, or should prevail, in a well-managed dairy herd, however, the desirable amount is probably nearer the maximum than the minimum figure quoted. Over short periods it may be possible to operate with a lower supply without apparent detriment to either milk yield or condition of the cow, but experience has shown that it is impossible to continue satisfactorily at such low levels for long periods. This has also been demonstrated experimentally by Haecker in America and by Möllgaard in Denmark.

Advisory practice in this country has long been based upon the Kellner standards, first published in 1905, which prescribe under ordinary practical conditions a daily allowance for maintenance (per 1,000 lb. live weight) of 0.5-0.7 lb. of digestible true protein, supplemented by 0.55-0.65 lb. of digestible true protein per 10 lb. of milk yield, the lower standards being intended for the less profitable and the higher for the more profitable conditions of milk production. For average conditions these standards may thus each be rounded

off to 0.6 lb., corresponding in most rations to about 0.7 lb. of digestible crude protein.

The tendency of subsequent experience and experiments has been to reduce these standards slightly. In 1929 Halnan published a review of the information then available, and proposed a standard of 0.6 lb. digestible "protein-equivalent" for maintenance, and 0.48-0.62 lb. per 10 lb. of milk, according to the fat-content of the latter (between 2.5 and 4.5 per cent.). In the same year Möllgaard propounded a standard of 0.45 lb. digestible true protein for maintenance and 0.51 lb. per 10 lb. of milk, whilst two years later Forbes in America advised 0.6 lb. digestible crude protein for maintenance and 0.42-0.59 lb. per 10 lb. of milk. Making allowance for the different forms of expression (true protein, protein equivalent, and crude protein) these newer standards are in substantial agreement at a slightly lower level than the old Kellner standards.

The subject has been recently reviewed by M'Candlish, whose conclusions are embodied in Research Bulletin No. 6, issued by the West of Scotland Agricultural College. He considers the crude protein basis to be the most suitable for practical purposes, and fixes the minimum maintenance requirements of the dairy cow at about 0.5 lb. digestible crude protein per 1,000 lb. live-weight per day, and a similar amount in addition for each 10 lb. of milk containing 3.5 per cent. of butter-fat. This standard is 20-25 per cent. lower than the 0.6 lb. " protein equivalent " standard recommended in 1925 by the Departmental Committee on Rationing of Dairy Cows. Expressed in terms of the concentrated food to be added to a maintenance ration, and assuming 3½ lb. of such food to be allowed per gallon of milk, this food should contain 14.3 per cent. of digestible crude protein (or about 19 per cent. of total crude protein) in order to provide the required 0.5 lb. of digestible crude protein.

This accords well with the observations made in the Scottish experiments and elsewhere, that milk yield tends to rise as the protein supply in the " production food " is raised, until the latter reaches the neighbourhood of 15 per cent. digestible crude protein, after which the rate of rise is small and probably only worth while in practice when foods rich in protein are low in price, or milk prices are relatively high. If the protein content of the production food is raised above 20 per cent. some cows may give a little more milk, but others will be

subject to digestive disturbance and consequent fall in production. At the best the supply of protein at this level can only be economic when a very cheap supply is available. For ordinary conditions the interests of economy are probably best served by following the advice of M'Candlish that the proportion of digestible crude protein in the " production food " should remain between 15 and 20 per cent., which will correspond to 20-26 per cent. total crude protein as shown by ordinary analysis. More often than not the lower level will be adequate.

Restricted Feeding of Pigs. In the " Notes " for February, 1937, reference was made to pig-feeding experiments, then in progress at Cambridge, on which a preliminary report had recently been issued. The object of these experiments was to compare the effects of two levels of food-supply upon rates of growth, efficiency of food utilization, carcass quality and financial returns. The pigs were fed individually and the comparisons made between litter brothers or sisters in pairs, one on the heavier and one on the lighter allowance of food. Up to 65 lb. liveweight each pig was allowed as much food as it would clear up in 20 minutes three times a day. Thereafter one pig of the pair continued on this " unrestricted " system, whilst the other pig, until it weighed 100 lb., was restricted to three-quarters of what its fellow ate when at the same weight, and from 100 lb. liveweight onwards it received two-thirds of its fellow's consumption.

The preliminary report dealt with the first experiment in which 20 pairs of pigs were included. The results were markedly favourable to restriction in every way, but as further tests on the same plan were to be made a final pronouncement was deferred.

The final report on the three experiments carried out is now available in the current volume of the *Journal of the Royal Agricultural Society*. In this report are given particulars of two further tests with ten and twenty pairs of pigs respectively, so that the whole series comprises fifty pairs. In almost every particular the indications of the first experiment were confirmed in each of the latter tests, the differences being only in the degree of advantage secured by restriction. Some of the averages of the data from the three tests combined are summarized in the appended table:

	50 *Unrestricted Pigs*	50 *Restricted Pigs*
Average age at Bacon Wt.	176·3 days	211·4 days
Live-weight Gain per day ..	1·54 lb.	1·15 lb.
Dead-weight Gain per day .	1·16 lb.	0·87 lb.
Food Consumption .. .	639·1 lb.	601·3 lb.
Average Food consumed per day	5·68 lb.	4·08 lb.
Food consumed per lb. (L.W. Gain)	3·72 lb	3·56 lb.
(D.W. Gain)	5·01 lb	4·76 lb.
% of Carcasses (above " standard ")	18 %	66 %
(below " standard ")	40 %	10 %

On the average the restricted pigs took 35 days longer to reach bacon weight, but nevertheless ate less food and showed more profit, the latter being in part due to superior back-fat grading. The saving through reduction of food consumption is estimated at 2*s*. 4½*d*. per pig, and the increased return due to better grading at 3*s*. 9*d*., or a total of 6*s*. 1½*d*. per pig, from which must be deducted charges for labour, etc., for the extra 35 days.

Whether the particular degree of restriction employed in these experiments represents the optimum level of feeding is uncertain, but the opinion is expressed that this optimum is probably in the neighbourhood of three-quarters of the quantity that the pig would consume if given as much as it will eat. Rough confirmation of this is given by the results of three restriction experiments on group-feeding lines carried out at the Harper Adams College. In these experiments, which comprised nearly 200 pigs, little further advantage was found from cutting down the food supply below the level represented by an average, over a 20-weeks feeding period, of about 4½ lb. per head per day, which is about 20-25 per cent. below the average daily consumption of the Cambridge " unrestricted " pigs. These experiments confirm also the Cambridge experience that if restriction is carried too far the rate of liveweight gain becomes so low that the quality of the carcass fat is adversely affected, and there is a risk of " soft " fat being produced.

In this connexion also it is interesting to note from the Cambridge report that of the unrestricted pigs those with a high efficiency of food utilization tended to have thicker back-fat (and therefore lower grading) than those with a low efficiency, whereas in the restricted group this correlation was reversed, the more " efficient " pigs giving the thinner back-fat and higher grading. It is pointed out that this " negative correlation " between " efficiency " and thickness

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Wheat, British ..	7 17	0 9	7 8	72	2 1	1·12	9·6
Barley, British feeding	8 15§	0 9	8 6	71	2 4	1·25	6·2
„ Canadian No. 3 Western ..	8 15	0 9	8 6	71	2 4	1·25	6·2
„ Argentine ..	8 12§	0 9	8 3	71	2 4	1·25	6·2
„ American ..	8 10†	0 9	8 1	71	2 3	1·21	6·2
„ Persian ..	8 10§	0 9	8 1	71	2 3	1·21	6·2
„ Russian ..	8 17†	0 9	8 8	71	2 4	1·25	6·2
Oats, English, white ..	8 13	0 10	8 3	60	2 9	1·47	7·6
„ „ black and grey	8 13	0 10	8 3	60	2 9	1·47	7·6
„ Scotch, white ..	8 18	0 10	8 8	60	2 10	1·52	7·6
„ Canadian—							
No. 2 Western	10 13*	0 10	10 3	60	3 5	1·83	7·6
Mixed feed ..	8 2	0 10	7 12	60	2 6	1·34	7·6
No. 1 feed ..	8 10§	0 10	8 0	60	2 8	1·43	7·6
Maize, American ..	6 18	0 7	6 11	78	1 8	0·89	7·6
„ Argentine ..	7 17	0 7	7 10	78	1 11	1·03	7 6
„ South African, No. 2 White Flat	7 5†	0 7	6 18	78	1 9	0·94	7·6
Beans, English, Winter	7 15§	0 18	6 17	66	2 1	1·12	19·7
Peas, English. blue ..	12 10§	0 15	11 15	69	3 5	1·83	18·1
„ Japanese ..	21 0†	0 15	20 5	69	5 10	3·12	18·1
Dari	9 10†	0 8	9 2	74	2 6	1·34	7·2
Milling Offals.—							
Bran, British ..	7 17	0 17	7 0	43	3 3	1·74	9·9
„ broad ..	8 5	0 17	7 8	43	3 5	1·83	10 0
Middlings, fine, imported	8 2	0 14	7 8	69	2 2	1·16	12·1
Weatings‡	8 0	0 15	7 5	56	2 7	1·38	10·7
„ Superfine‡	8 7	0 14	7 13	69	2 3	1·21	12·1
Pollards, imported ..	7 15	0 15	7 0	50	2 10	1·52	11·0
Meal, barley	9 12	0 9	9 3	71	2 7	1·38	6·2
„ „ grade II	8 17	0 9	8 8	71	2 4	1·25	6·2
„ maize	7 15	0 7	7 8	78	1 11	1·03	7·6
„ „ South African	7 10	0 7	7 3	78	1 10	0·98	7·6
„ „ germ ..	8 0	0 11	7 9	84	1 9	0·94	10·3
„ locust bean ..	7 15	0 6	7 9	71	2 1	1·12	3·6
„ bean	9 7	0 18	8 9	66	2 7	1·38	19·7
„ fish (white) ..	15 0	2 6	12 14	59	4 4	2·32	53·0
„ Soya bean (extracted)‡ ..	9 2	1 11	7 11	64	2 4	1·25	38·3
Maize, cooked, flaked	8 2	0 7	7 15	84	1 10	0·98	9·2
Linseed cake—							
English, 12% oil ..	10 12	1 1	9 11	74	2 7	1·38	24·6
„ 9% „ ..	10 0	1 1	8 19	74	2 5	1·29	24·6
„ 8% „ ..	9 15	1 1	8 14	74	2 4	1·25	24·6
Cottonseed cake—							
English, Egyptian seed, 4½% oil ..	5 10	0 19	4 11	42	2 2	1·16	17·3

PRICES OF FEEDING STUFFS (*continued*)

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Cottonseed cake, Egyptian, 4½% oil ..	5 2	0 19	4 3	42	2 0	1·07	17·3
Cottonseed cake decorticated, 7-8% oil	7 15†	1 10	6 5	68	1 10	0·98	34·7
Cottonseed meal, decorticated, 7-8% oil	8 2†	1 10	6 12	70	1 11	1·03	36·8
Coconut cake, 5% oil ..	7 17†	0 19	6 18	77	1 10	0·98	16·4
Ground nut cake, 6–7% oil	7 0*	1 0	6 0	57	2 1	1·12	27·3
Ground nut cake, decorticated, 6-7% oil	8 2*	1 9	6 13	73	1 10	0·98	41·3
Ground nut cake, imported decorticated, 6–7% oil	7 7	1 9	5 18	73	1 7	0·85	41·3
Palm-kernel cake, 4½-5½% oil	7 10†	0 13	6 17	73	1 11	1·03	16·9
Palm-kernel cake meal, 5½% oil	7 15†	0 13	7 2	73	1 11	1·03	16·9
Palm-kernel meal, 1–2% oil	7 0	0 13	6 7	71	1 9	0·94	16·5
Feeding treacle ..	5 0	0 8	4 12	51	1 10	0·98	2·7
Brewers' grains, dried ale	6 15	0 12	6 3	48	2 7	1·38	12·5
Brewers' grains, dried porter	6 7	0 12	5 15	48	2 5	1·29	12·5
Dried sugar-beet pulp	From £6 2s. 6d to £6 17s 6d. per ton, ex-factory (according to factory)						

* At Bristol. § At Hull. † At Liverpool.

‡ In these instances manurial value, starch equivalent and protein equivalent are provisional.

NOTE. The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex-mill or store. The prices were current at the beginning of March, 1938, and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative values of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, if linseed cake is offered locally at £11 per ton, then since its manurial value is £1 1s. per ton, as shown above, the cost of food value per ton is £9 19s. Dividing this figure by 74, the starch equivalent of linseed cake as given in the table, the cost per unit of starch equivalent is 2s. 8d. Dividing this again by 22·4, the number of pounds of starch equivalent in one unit, the cost per lb. of starch equivalent is 1·43d. Similar calculations will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own markets. The figures given in the table under the heading manurial value per ton are calculated on the basis of the following unit prices :—N., 7s. 7d., P_2O_5, 2s. 7d.; K_2O, 3s. 8d.

The Agricultural Index Number, February, 1938

The general index number of prices of agricultural produce for February at 130 (base, February, 1911-13=100) was 4 points below that recorded for January, but 1 point higher than for February, 1937. If allowance be made for payments under the Wheat Act, 1932, and the Livestock Industry Act, 1937, the revised index for the month becomes 135. Compared with January, average prices of bacon pigs were higher, while those of fat cattle and milk showed no alteration. With these exceptions, price movements of practically all other commodities used in compiling the index were downwards.

Monthly index numbers of prices of Agricultural Produce (Corresponding months of 1911–13 = 100)

Month	1933	1934	1935	1936	1937	1938
January .	107	114	117	119	130	134
February	106	112	115	118	129	130
March . .	102	108	112	116	130	—
April ..	105	111	119	123	140	—
May .	102	112	111	115	133	—
June . ..	100	110	111	116	131	—
July . ..	101	114	114	117	131	—
August . ..	105	119	113	119	133	—
September	107	119	120	127	137	—
October . ..	107	114	113	125	131	—
November .. .	109	114	113	125	133	—
December . .	110	113	114	126	132	—

Revised monthly index numbers of prices of Agricultural Produce, allowing for payments under the Wheat Act (a) and for the Cattle subsidy (b).

Month	1933	1934	1935	1936	1937	1938
January	111	119	124	125	133	138
February	110	117	122	123	133	135
March	106	112	118	122	134	—
April	109	116	126	128	143	—
May	105	116	117	120	136	—
June	104	114	117	121	134	—
July	104	117	120	121	134	—
August	108	122	120	124	136	—
September .. .	111	125	128	133	142	—
October	112	121	119	129	134	—
November	113	120	119	129	137	—
December	114	120	120	130	136	—

(*a*) Commenced August, 1932. (*b*) Commenced September, 1934.

In the following table the monthly index numbers of prices of individual commodities are shown for the months of November, 1937, to February, 1938; February, 1937, and February, 1936; base, the corresponding months of 1911-13=100.

Commodity	1938		1937		1937	1936
	Feb.	Jan	Dec.	Nov.	Feb.	Feb
Wheat	109	114	116	120	122	85
Barley	156	165	160	152	124	98
Oats	119	124	119	120	116	85
Fat cattle	121	123	113	113	99	96
„ sheep	122	133	131	137	137	119
Bacon pigs	132	134	131	129	126	111
Pork „	135	140	139	137	125	114
Eggs	122	120	121	126	115	118
Poultry	130	133	130	132	121	122
Milk	181	181	181	181	171	171
Butter	105	105	110	116	97	93
Cheese	121	125	120	121	107	95
Potatoes	140	142	152	156	201	200
Hay	76	77	79	79	98	83
Wool	115	122	117	133	131	96
Dairy cows	123	123	121	119	111	103
Store cattle	123	119	112	107	101	92
„ sheep	102	113	112	116	115	104
„ pigs	151	164	159	167	139	129

Revised index numbers due to payments under the Wheat Act and to the Cattle subsidy

Wheat	134	135	135	132	134	122
Fat cattle	136	138	127	128	114	110
General Index	135	138	136	137	133	123

Grain. Wheat, at 8*s.* 1*d.* per cwt., averaged 3*d.* less on the month and the index falls by 5 points. If the deficiency payment under the Wheat Act, 1932, is taken into account, the index is 134. Barley at 12*s.* 7*d.* per cwt. and oats at 8*s.* 5*d.* per cwt. declined by 7*d.* and 1*d.* respectively, the relative indices moving downwards by 9 and 5 points. In February, 1937, wheat averaged 9*s.* 1*d.*, barley 10*s.* and oats 8*s.* 3*d.* per cwt.

Live Stock. Fat Cattle, at 41*s.* 11*d.* per live cwt. for second quality, were unchanged on the month but, owing to a slight rise having occurred during the base period, the

current index is 2 points lower. If the subsidy under the Livestock Industry Act, 1937, is added, the index becomes 136. Average quotations for second quality fat sheep were ¼*d.* lower at 9¾*d.* per lb. and the index falls by 11 points, the decline having been accentuated by a reverse movement in the base price. Bacon pig prices advanced by 2*d.* to 12*s.* 11*d.* per score (20 lb.) but, with a relatively greater upward trend during the corresponding months of 1911-13, the index declines by 2 points. Quotations for pork pigs were reduced by 2*d.* to 14*s.* 4*d.* per score (20 lb.) and the index recedes by 5 points.

Prices of dairy cows showed little change on the month, the index remaining at 123; store cattle, however, were dearer and the index is higher by 4 points. Quotations for store sheep and pigs declined, the indices being reduced by 11 and 13 points respectively.

Dairy and Poultry Produce. The regional price of liquid milk continued unchanged and the index remains at 181. At 1*s.* 3¼*d.* per lb., butter was slightly lower in price but, with a similar movement in the base months, the index shows no alteration. Eggs, at 13*s.* 11*d.* per 120, were reduced by 1*s.* 6*d.* but, a proportionately greater fall having taken place in the months of February, 1911-13, the index advances by 2 points. Cheese, at £4 10*s.* per cwt., averaged 1*s.* less than in January and the index recedes by 4 points. Price movements of poultry were mostly downwards, the combined index being 3 points lower.

Other Commodities. Potatoes, which averaged £5 8*s.* per ton, showed a slight reduction in price as compared with January, and the index declines by 2 points. Quotations for both clover hay, at £3 18*s.*, and meadow hay, at £2 15*s.* 6*d.* per ton, were somewhat lower, the combined index falling by 1 point. The average price of wool declined from 1*s.* 3⅜*d.* to 1*s.* 2⅝*d.* per lb., and the index moves downwards by 7 points.

Prize Essays in Agricultural Economics

The Agricultural Economics Society has decided to offer two annual prizes of £10 and £5 respectively for essays on subjects connected with the economics of agriculture. Competitors must be either students at recognized institutions or holders (of not more than two years' standing) of degrees and/or diplomas in agriculture and/or economics. Essays

for the current year must be sent in by March 31, 1939, and must be on one of the following subjects;—

(a) A study of factors influencing changes in the size distribution of agricultural holdings in the United Kingdom since 1900.
(b) Agricultural credit facilities in Great Britain.
(c) The future of organized marketing in Great Britain.

Further details will be supplied on request to The Secretary, The Agricultural Economics Society, University of Reading, 7, Redlands Road, Reading.

Sampling Observations on Wheat, 1937-38: Report for First Quarter

These observations are part of a detailed study of the growth of two varieties of wheat, Squarehead's Master and Yeoman, at a number of centres throughout the country. The present scheme is now in its sixth season. The measurements enable us to study the effects of weather on the growth of the crop and to judge how accurately yields can be predicted from the state of the crop some time before harvest. These are topics on which every intelligent farmer has his ideas, obtained from watching his own commercial crops, and one of the most interesting results of the scheme will be its confirmation, or otherwise, of popular opinions. It has already been shown, for instance, that too high a plant population is not desirable; better yields are obtained from moderate plant populations in which the plants compete less with each other. Further, the total numbers of shoots, when these are at their greatest, bear little relation to the final yields.

The first quarter's observations are summarized in the Table, which shows the date of sowing, the date of appearance above ground and the plant population at the first count, which is made about three weeks after appearance. The averages of the last two observations for the past five seasons are also given.

Thus far the progress of the crop has been normal this season. The mean sowing date for the nine stations was October 31. Appearance above ground took place on the average about 26 days later. Yeoman was as usual slightly ahead of Squarehead's Master at all six stations that determined the date of appearance accurately. Plant numbers at the first count are lower than usual at most stations. The sparse crop at Newport is mainly due to bird damage, but the plant is an even one and good tillering is anticipated.

SAMPLING OBSERVATIONS ON WHEAT, 1937–38: FIRST QUARTER

Station	Variety	Sowing Date	Date of Appearance Above Ground		Plant density per 32 Metres — First Count		
			1937	Average 1932–7	1937–8	Average 1932–7	Date
Wye, Kent .	S H M * ..	Oct 7	Oct 19·25	Nov 27·6	1,677	1,518	Nov 10
	Yeoman	—	Oct 18 88	Nov 27 0	1,774	1,707	—
Plumpton, Sussex	S H M	Oct 20	†	Nov 28·3	1,436	825	Nov. 25
	Yeoman	—	†	Nov 26·9	1,410	962	—
Cirencester, Gloucestershire	S H M	—	Nov. 4 06	†	1,467	1,317	—
	Yeoman	Oct 21	Nov 2 66	†	1,518	1,533	Nov 18
	Little Joss	—	Nov 4·31	†	775	—	—
Newport, Shropshire ..	S H M	Oct 27	Nov 26	Dec 12·8	525	708	Jan 4
	Yeoman	—	Nov 27	Dec. 13·2	489	687	—
Boghall, Edinburgh	S H M	Nov. 4	Before	Dec 15·7	1,261	1,730	Jan 7
	Yeoman	—	Dec 14	Dec 16 1	1,404	1,814	—
Woburn, Bedfordshire	S H M	Nov 4	Dec 2·12	Nov 17·8	1,528	1,582	Dec 31
	Yeoman	—	Dec 1·84	Nov. 18·5	1,381	1,747	—
Newton Abbot (Seale-Hayne Coll.), Devonshire .	S H M	—	Nov 26·34	Nov 3·7	1,512	1,704	—
	Yeoman	Nov 6	Nov 24·75	Nov 2·9	1,638	1,867	Dec 30
	Victor	—	Nov 26·19	—	1,836	—	—
Rothamsted, Hertfordshire .	S H M	—	Dec 14·56	Nov 9·6	1,095	1,662	—
	Yeoman	Nov 10	Dec 11·56	Nov 8·8	1,180	1,778	Jan 3
	Victor	—	Dec 14·34	—	1,148	—	—
Sprowston, Norfolk .	S H M	Nov 22	Dec 25·41	Nov 30·4	865	1,723	Jan 17
	Yeoman	—	Dec 23·09	Nov 30·2	890	1,818	—

* = Squarehead's Master † = Observations incomplete

The Ministry's Advisory Publications

Bulletins. The following new and revised Bulletins have been published this year:—

No. 3.—The Improvement of Grassland (5th Edition) 1*s.* 6*d.* (1*s* 8*d.*, post free).

A largely re-written edition issued in view of the Land Fertility campaign. See page 10 for more complete information.

No. 6—Some Diseases of Poultry. (5th Edition) 1*s.* 6*d* (1*s.* 8*d*, post free).

Reproduces the 4th edition with the addition of sections on Fowl Paralysis and Contagious Bronchitis of Poultry, and an introduction describing the action taken under the Diseases of Animals Act, 1935, which made provision for applying the Diseases of Animals Acts to poultry.

No 35.—The Use of Lime in Agriculture. (3rd Edition.) 6*d.* (7*d*, post free).

A re-written edition intended to assist farmers in working out a liming policy now that lime is available at half-cost on the farm.

No. 43.—Farm and Factory Cheese-making. (2nd Edition) 1*s.* (1*s.* 3*d*, post free)

This Bulletin has been substantially revised in the light of recent developments in the milk industry and the manufacture of milk products, and extended to meet the requirements of both farm and factory

No 52.—Modern Milk Production (2nd Edition) 9d (11*d.*, post free).

The original text has been extensively revised and several new sections added.

No 103.—Crops for Pickling. 9*d* (10*d*, post free)

Brings together the essential details regarding the cultivation and subsequent treatment on the farm of vegetables likely to be required by pickle manufacturers

Copies of the above are obtainable at the prices mentioned from the Sale Offices of H.M. Stationery Office.

Advisory Leaflets. Since the date of the list published in the January, 1938, issue of this JOURNAL (p. 1030), the under-mentioned Advisory Leaflets have been issued by the Ministry:—

No 16—Coccidiosis in Poultry (Revised)
No 19.—Fowl Cholera (Revised)
No 115.—Slugs and Snails. (Revised)
No 134.—Improvement of Poor Upland Pasture. (Revised)
No 150.—Millepedes and Centipedes. (Revised.)
No 225.—Cutworms or Surface Caterpillars. (Revised.)
No. 263.—Tomato Leaf Mould Disease. (Revised.)
No. 290.—Spraing, Internal Rust Spot, and Net Necrosis of the Potato Tuber.
No. 291.—Black Scurf and Stem Canker of the Potato.
No. 292.—Pink Rot and Watery Wound Rot of Potatoes.

Copies of any of the above-mentioned leaflets may be purchased from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2, or at the Sale Offices of that Department at Edinburgh, Manchester, Cardiff, and Belfast,

price 1*d*. each net (1½*d*. post free), or 9*d*. net per doz. (10*d*. post free).

Single copies of not more than 20 leaflets may, however, be obtained, free of charge, on application to the Ministry. Further copies beyond this limit must be purchased from H.M. Stationery Office, as above.

A list of the Ministry's publications, including leaflets, on agriculture and horticulture may be obtained free and post free on application to the Ministry.

Accredited Poultry Breeding Stations

In view of the recent report of the Poultry Technical Committee for Great Britain, in which recommendations were made, *inter alia*, for the establishment of a voluntary grading scheme for the production of higher quality stock (see issue of this JOURNAL for March, 1938, p. 1170), it is thought that the following account of the Scheme of Accredited Poultry Breeding Stations, as it has been conducted hitherto in England and Wales, may be of interest.

The main objects of the scheme are to assist poultry breeders in obtaining healthy stock of good quality and to combat the spread of disease. The Scheme was started in a modest way as a county scheme under the supervision of County Poultry Instructors, who, in the course of their duties in the counties, are often asked to advise on the purchase of suitable stock. Administration is in the hands of those county authorities who have adopted the Scheme and is carried out in any such county by a poultry sub-committee, which is responsible for selecting and accrediting breeding farms, and which works through the agricultural educational staffs. The county poultry instructor, with his knowledge of local conditions, is well qualified to advise his committee on the selection and supervision of accredited farms. The part played by the Ministry is one of co-ordination, so that the rules on which the conduct of the Scheme rests shall be comparable in all counties; in addition, the Ministry publishes annually a complete register of all accredited breeding stations.

There is no compulsion on a breeder to enter the Scheme, but if he elects to do so he is compelled to abide by the rules governing the Scheme. Poultry instructors, in selecting farms in their county, realize that they have an important duty to perform, not only to breeders, but also to the public who purchase stock and hatching eggs, and in discharging this

duty, give careful consideration to quality and health of stock.

In estimating the quality of the stock such factors as the number and weight of eggs laid in a given period, and the type of bird are taken into consideration; and, in addition, standards are laid down for the size of hatching eggs sold to purchasers in the different grades. In order to meet the requirements of different classes of poultry keepers, certain grades of stock are necessary. There are two main grades known as "Breeder's Grade" and "Commercial Grade." The Breeder's Grade has two sections—one for egg production and another for table poultry production. Both of these sections are intended for pure-bred stock of breeding standard. The Commercial Grade supplies requirements for both egg production and table poultry production.

As regards the health of stock the regulations require the breeder to satisfy the county authority that his farm is, and has been, free from disease and that his stock is in a healthy condition at the time it is accredited. As a safeguard against distribution of unhealthy stock, all outbreaks of disease must be reported immediately to the Accrediting Authority, who may, if necessary, order the sale of hatching eggs and stock to be discontinued until satisfactory evidence is produced to show that such sales may safely be resumed. As regards the control of a specific disease such as Bacillary White Diarrhoea, the industry is fortunate in the facilities provided for the application of the Blood Agglutination Test as a definite control measure against a disease that has caused extensive losses amongst chickens in the past. All station holders, before they are accredited must produce evidence that they have tested their flocks, and no bird is to be bred from until it has passed the Blood Agglutination Test. There are two classes of station for the purpose of the Test—Class A and Class B.

In *Class A* every hen, pullet and cock or cockerel five months old or over must be subjected annually to the Blood Agglutination Test between July 1 and October 15. With *Class B* stations the breeder must test the whole of his breeding stock in the same manner as for Class A. Every bird that fails to pass the blood test in either class must be killed and removed from the farm.

The main reason for allowing two classes of farms for the blood agglutination test is to meet the requirements of breeders who, whilst possessing stock of good health and a high

standard of production, are not willing to undertake the extra labour and expense of testing the whole of their birds. At the present stage of the Scheme, Class B stations are in the minority, representing only 19 per cent. of all stations in the season 1937-38.

The progress that accreditation has made within the last six years is encouraging. The Scheme started in a few counties in 1932-33, when 17 local authorities accredited 121 farms, of which 71 per cent. (86) were Class A and 29 per cent. Class B. In the table given below it will be seen that there has been a gradual increase in the number of counties entering the Scheme up to the 1937-38 season. During the present season (1937-38), 34 counties have adopted the Scheme with 205 farms accredited.

ACCREDITED POULTRY BREEDING STATIONS

	1932 to 1933	1933 to 1934	1934 to 1935	1935 to 1936	1936 to 1937	1937 to 1938
Number of Counties operating Scheme . ..	17	26	30	31	35	34
Number of Class A stations	86	109	131	133	154	164
Number of Class B stations	34	49	41	31	47	38
Total number of stations (including those dealing with ducks)	121	161	175	168	206	205

To meet the changing circumstances of the industry and to make full use of experience gained in running the Accredited Scheme the rules and regulations have been submitted periodically to careful revision by those concerned in its administration, and also by the Accredited Poultry Breeders' Federation, a body formed to represent station holders and to help forward the working of the Scheme.

Copies of the current Register may be obtained free of charge from The Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1.

Wart Disease of Potatoes Order of 1923

A case of considerable interest to English potato growers was heard at Shifnal on February 18, when a Staffordshire farmer was prosecuted by the Ministry of Agriculture and Fisheries for a contravention of the Wart Disease of Potatoes Order of 1923, which provides that no potatoes grown in an Infected Area shall be moved or consigned to any place in England that is not in an Infected Area. The defendant

pleaded " guilty " to having consigned a quantity of King Edward VII potatoes, which had been grown in an Infected Area, to London, which is not in an Infected Area, and he was fined £1 with £5 16s. costs.

Growers are reminded that the restriction on the movement of potatoes grown in an Infected Area applies to all classes of potatoes, whether they are intended for planting or for consumption. The only exception is that of ware potatoes of approved immune varieties, and these must be accompanied by a statement to the effect that they are of an approved immune variety, that they were grown in an Infected Area, and that they are not intended for planting. It should also be remembered that any person who moves or consigns or causes to be moved or consigned any potatoes in contravention of this Article of the Order is liable to prosecution; dealers residing in clean areas should accordingly make sure that any potatoes purchased are not subject to the above-mentioned restrictions.

Post-Graduate Agricultural Scholarships and Refresher Course Grants

The Ministry of Agriculture and Fisheries and the Department of Agriculture for Scotland invite applications for (i) agricultural scholarships from students who propose to follow the career of Agricultural Organizer or Instructor or Lecturer in Agriculture (including horticulture, dairying and poultry husbandry), and (ii) grants for refresher courses for Agricultural Organizers, Instructors and Lecturers already employed on the staffs of County Agricultural Educational Authorities in England and Wales and from County Organizers and Instructresses on the staffs of Agricultural Colleges in Scotland. The selection from candidates will be by interview, and the allocation of the scholarships and grants between the applicants from England, Wales and Scotland will be made entirely on the basis of merit.

AGRICULTURAL SCHOLARSHIPS. The object of the scholarships, of which not more than 4 will be awarded annually, is to broaden the agricultural knowledge and experience of students and so to qualify them for the position of agricultural organizer, instructor, or lecturer.

Candidates must be British born, and should be graduates of a University, but exceptional candidates, otherwise

qualified, who have not had an opportunity of graduating, will be regarded as eligible. Application may also be made in respect of candidates who have sat for a Degree or Diploma examination of which the result has not been announced. In addition, candidates should have had some experience of practical farming. Candidates must be nominated by a Professor, Principal or Lecturer of a University or College on the prescribed form.

The value of the scholarships will not exceed £200 together with an allowance for approved fees and travelling expenses. The amount may be varied in accordance with the scholar's means and may cover the whole of the cost of training, including maintenance, or a proportion only of such cost.

The period of the scholarships is normally one year and commences on October 1. It will be spent at such agricultural educational or research institutions, advisory centres or farms as the Ministry or the Department may direct.

REFRESHER COURSE GRANTS. The purpose of the refresher course grants is to provide means and opportunity for those already engaged in agricultural educational work to widen their knowledge of particular branches of agriculture and to become acquainted with recent advances on the scientific side of the subject. Applications for grants for this purpose must be made on the prescribed form to the Ministry or the Department, and must be approved by the Authority or the governing body of the College by whom the applicant is employed and by whom the salary of the applicant would be payable during the period of the course.

The period of a course will normally be about 4 weeks, and in any instance will not exceed 8 weeks, and will be spent at such agricultural educational or research institutions, advisory centres or farms as the Ministry or the Department may approve. Reasonable travelling and subsistence expenses and any fees incurred by a successful applicant in taking a course will be defrayed.

Forms of application for both the agricultural scholarships and the refresher course grants and all other particulars may be obtained by English and Welsh applicants from the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1, and by Scottish applicants from the Secretary, Department of Agriculture for Scotland, 29, St. Andrew Square, Edinburgh, 2. The latest date for receiving applications is June 1, 1938.

Meat Production and Trade

The report on meat recently published by the Imperial Economic Committee provides an interesting and useful summary of the figures relating to world production and trade and the course of prices in the United Kingdom market in the period 1930-36.* In addition, there are appendices on "Regulation of imports into the United Kingdom," and on "Import duties and restrictions in foreign countries."

The total amount of meat entering world trade in 1936 appears to have been about the same as in 1935, beef exports showing an increase, mutton and lamb a decline, and pig meat little change. In the aggregate, meat consumption in Great Britain was slightly less than in 1935, but home-produced supplies increased, a decline in the mutton and lamb output being more than offset by the expansion of the output of beef and pig meat.

World production and consumption of beef probably reached a new high level in 1936, while the quantity entering international trade was the largest since 1931. The United Kingdom imported a greater quantity and there was also a relatively large increase in imports into Germany. Of the total imports into the United Kingdom, the share of Empire countries amounted to 23 per cent. This was slightly less than in the previous year, but there was a continued expansion of chilled beef imports from Empire countries, which amounted to 600,000 cwt., representing about 7 per cent. of total chilled beef imports. The home output of beef, which also increased, comprised just under one-half of total supplies, or about the same as in 1935 and a greater proportion than in any other recent year. Apparent consumption of beef per head in Great Britain increased for the fourth successive year, and, at 70 lb., was 1 lb. greater than in 1935. The long downward trend in the price of home-produced beef was reversed in 1936 and imported beef was unchanged; the prices of all descriptions advanced in 1937.

International trade in mutton and lamb, which is directed almost exclusively to the United Kingdom market, continued to show the declining tendency which had been in evidence since 1931. Of total United Kingdom imports, the Empire's

* *Meat: A summary of figures of production and trade relating to beef, mutton and lamb, bacon and hams, pork, cattle, sheep, pigs and canned meat.* Obtainable from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2, price 2*s.* 6*d.*, post free 2*s.* 8*d.*

share in 1936 amounted to 80 per cent. as compared with 64 per cent. in 1930. It is interesting to note also that shipments of lamb continued to displace those of mutton, imports of which showed a decline of 45 per cent. as compared with 1930, while lamb imports increased by 26 per cent. The home output of mutton and lamb in Great Britain was smaller in 1936 than in the previous year, and the consumption per head of mutton and lamb, at the equivalent of 30 lb., declined for the third successive year. Prices of home-produced mutton and lamb also declined somewhat in 1936, but a recovery took place in the first half of 1937.

World production of pig meat in 1936 showed a reversal of the downward tendencies of the previous three years, but it is probable that production in Europe will decline in 1937-38, while an increase is expected in the United States, which is by far the largest single producer. The downward trend of international trade in pig meat was checked in 1936, a further decline in bacon being offset by increased exports of pork. Denmark supplies about half of the United Kingdom imports of bacon and hams, but the share of Empire countries increased from less than 5 per cent. in 1932 to 26 per cent. in 1936. Empire countries, in 1936, supplied about 80 per cent. of the imports of pork into the United Kingdom. The United Kingdom output of pig meat in 1936 was the largest ever recorded, and represented fully 50 per cent. of total supplies, as against 44 per cent. in 1934, and an average of 35 per cent. in the previous five years. The apparent consumption of pig meat was equal to 44 lb. per head, or the same as ten years earlier. Prices for both bacon and pork in the United Kingdom in 1936 were slightly higher than in 1935, and a further advance took place in 1937.

APPOINTMENTS

COUNTY AGRICULTURAL EDUCATION STAFFS: ENGLAND

Devonshire: Miss C. J. W. Gall, B.Sc. (Agric.), N.D.D., C.D.D., has been appointed Instructress in Rural Science *vice* Miss D. J. Corfield, N.D.D., U.D.D., B.D.F.D.

Hampshire: Miss J. C. Cockburn, N.D.D., has been appointed Assistant Instructress in Dairying *vice* Miss F. J. Atkinson, N.D D.

Staffordshire: Mr. B. H. Harvey, B.Sc. (Agric.), N.D.A., N.D.D., has been appointed Lecturer in Agriculture, and Mr. R. Kenney, B.Sc. (Agric.), N.D.D., has been appointed Warden of the Farm Institute and Lecturer in Dairying.

WALES

Monmouthshire: The death is announced of Mr. C. H. King, County Poultry Adviser.

WIRELESS TALKS, APRIL, 1938

Station and Date	*Time: p m*	*Speaker*	*Subject*
National:			
April 6	6 20	Mr A Hurd	Soil Fertility
,, 13	6 20	,,	Agricultural Education
,, 20	6 20	,,	The Farmer and His Men
,, 27	6 20	Prof J A. Scott-Watson	—
North:			
April 8	6 45	Messrs J A. Hanley and J Strachan	Clover
Midland:			
April 14	6 35	Mr W A. Stewart	Grass-fed Beef
West:			
April 7	9 30	Messrs A W Ling and A Thompson	Scholarships
,, 14	6 40	—	Pigs
Welsh:			
April 8	7 30	Discussion	Use of Lime and Basic Slag.
,, 11	6 45	A Rat Catcher	Unusual Occupations
Scottish:			
April 7	6 30	Mr A D. Buchanan Smith	—
,, 14	6 20	Mr J. Mackie	The Tractor on the Farm
,, 21	6 50	Mr J. F Duncan	—
,, 27	6.40	Mr. A. E Cameron	The Turnip Flower
Northern Ireland:			
April 4	7.30	Regional Director	Agricultural Broadcasting
,, 4	7 40	—	For Ulster Farmers.
,, 25	--	Discussion	—

FARM WORKERS' MINIMUM RATES OF WAGES

Farm Workers' Minimum Rates of Wages.—A meeting of the Agricultural Wages Board was held at Kings Buildings, Smith Square, London, S.W.1, on February 22, 1938.

The Board considered notifications from Agricultural Wages Committees of decisions fixing minimum and overtime rates of wages, and proceeded to make the following Orders.—

Dorset.—An Order varying the existing minimum and overtime rates of wages, the rates as varied came into operation on March 6, 1938, and continue in force until June 30, 1938. The minimum rates in the case of male workers of 21 years of age and over are 33*s.* (unchanged) per week of 42 hours in the weeks in which Good Friday, Easter Monday and Whit Monday fall, and 51 hours in any other week, with, in addition, not more than 3 hours employment in connection with milking and the care of and attendance upon stock on each of the public holidays. The overtime rate is 9*d.* per hour (instead of 8*d*). The minimum rates for female workers of 21 years of age and over are 24*s.* (unchanged) per week of 39½ hours in the weeks in which Good Friday, Easter Monday and Whit Monday fall, and 48 hours in any other week with, in addition, not more than 3 hours employment in connection with milking and the care of and attendance upon stock on each of the public holidays. The overtime rate in the case of female workers of 20 years of age and over is unchanged at 6*d* per hour.

Hertford.—An Order varying the existing minimum and overtime rates of wages, the rates as varied came into force on February 27, 1938, and continue in force until further notice. The minimum rates in the case of male workers of 21 years of age and over are 35*s.* (instead of 34*s*) per week of 39½ hours in the weeks in which Easter Monday and Whit Monday fall; 31 hours in the week in which Christmas Day and Boxing Day fall together; 39½ hours in the weeks in which Christmas Day and Boxing Day fall, when these days fall in separate weeks, and 48 hours in any other week with overtime at 8¾*d* per hour (instead of 8½*d.* per hour) for all employment on Easter Monday, Whit Monday Christmas Day and Boxing Day and in excess of the above-mentioned numbers of hours, and 11*d* per hour (unchanged) for all employment in excess of 5½ hours on Saturday or other agreed weekly short day (not being Sunday, Easter Monday, Whit Monday, Christmas Day or Boxing Day). The minimum rate in the case of female workers of 19 years of age and over is 29*s* (instead of 28*s.*) per week of the numbers of hours mentioned above in the case of male workers, with overtime at 7¼*d.* per hour (instead of 7*d.* per hour) for all employment on Easter Monday, Whit Monday, Christmas Day and Boxing Day, and in excess of the above-mentioned numbers of hours, and 9*d.* per hour (instead of 8¾*d.* per hour) for all employment in excess of 5½ hours on Saturday or other agreed weekly short day (not being Sunday, Easter Monday, Whit Monday, Christmas Day or Boxing Day).

Middlesex.—An Order fixing minimum and overtime rates of wages came into force on March 6, 1938 (i.e., the day following that on which the existing rates expired), and continues in operation until March 4, 1939. The minimum rates are (1) in the case of workers employed wholly or mainly on the duties of stockmen, for male workers of 21 years of age and over, 46*s.* 3*d.* (instead of 43*s.* 9*d.*) and for female workers of 18 years of age and over 33*s.* 9*d.* (instead of 31*s.* 3*d.*) per week of 40 hours in the week in which Christmas Day and Boxing Day fall, 50 hours in

the weeks in which Easter Monday, Whit Monday, August Bank Holiday and any other Bank Holiday which may be proclaimed by Royal Proclamation fall, and 60 hours in any other week; in the case of workers employed wholly or mainly as carters, for male workers of 21 years of age and over, 43*s*. 2*d*. (instead of 40*s*. 10*d*.) and for female workers of 18 years of age and over, 31*s*. 6*d*. (instead of 29*s*. 2*d*.) per week of 38 hours in the week in which Christmas Day and Boxing Day fall, 47 hours in the weeks in which Easter Monday, Whit Monday, August Bank Holiday and any other Bank Holiday which may be proclaimed by Royal Proclamation fall, and 56 hours in any other week; in the case of casual workers, for male workers of 21 years of age and over, 9½*d*. per hour (instead of 8¾*d*. per hour) and for female workers of 18 years of age and over, 6¾*d*. per hour (instead of 6¼*d*. per hour) and in the case of workers other than those specified above, for male workers of 21 years of age and over, 38*s* 6½*d*. (instead of 36*s*. 5½*d*) in summer and 37*s* (instead of 35*s*.) in winter, and for female workers of 18 years of age and over, 28*s* 1½*d*. (instead of 26*s*. 0½*d*.) in summer and 27*s*. (instead of 25*s*) in winter per week of 42 hours in the weeks in which Easter Monday, Whit Monday, August Bank Holiday and any other Bank Holiday which may be proclaimed by Royal Proclamation fall, 30 hours in the week in which Christmas Day and Boxing Day fall, 50 hours in any other week in summer, and 48 hours in any other week in winter. The overtime rate in the case of all male workers of 21 years of age and over is 10½*d*. per hour (instead of 10¼*d*.) and in the case of female workers of 18 years of age and over, 7¾*d* per hour (instead of 7½*d*).

Monmouth.—An Order continuing the operation of the existing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers from March 16, 1938 (i e., the day following that on which the existing rates expired) until September 15, 1938. The minimum rates are in the case of male workers of 21 years of age and over, 34*s*. per week of 54 hours, with overtime at 9½*d*. per hour on week-days and 11½*d*. per hour on Sundays, Good Friday, Easter Monday, Whit Monday and August Bank Holiday. The minimum rate in the case of female workers of 17 years of age and over is 6½*d*. per hour for all time worked

Shropshire—An Order varying the existing minimum and overtime rates of wages, the rates as varied came into operation on March 6, 1938, and continue in force until further notice. The minimum rates in the case of male workers of 21 years of age and over are 35*s*. (instead of 34*s*.) per week of 44½ hours in the weeks in which Christmas Day and Good Friday fall, and 54 hours in any other week, with overtime unchanged at 9*d*. per hour on weekdays and for attention to stock on Sundays and 10*d*. per hour for other employment on Sundays. The minimum rates in the case of female workers of 18 years of age and over remain unchanged at 5*d*. per hour with overtime at 6*d*. per hour.

Somerset.—An Order fixing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers came into operation on March 27, 1938 (i.e., the day following that on which the existing rates expired) and continues in force until March 25, 1939. The minimum rates in the case of male workers of 21 years of age and over are 36*s*. (instead of 34*s*.) per week of 52 hours in summer except in the weeks in which Good Friday, Easter Monday, Whit Monday and August Bank Holiday fall when the hours are 42¾; and 50 hours in winter except in the week in which December 24, 1938, and Boxing Day fall, when the hours are 41½ with overtime at 9*d*. per hour, except for overtime employment on the hay and corn harvests when the rate

is 10*d*. per hour (as formerly). Provision is made for the adjustment of the hours in respect of which the minimum weekly wage is payable in the weeks in which Good Friday, Easter Monday, Whit Monday, August Bank Holiday, December 24, 1938, and Boxing Day fall, to meet cases where alternative holidays are given within 14 days of such public holidays. The minimum rate for female workers of 21 years of age and over is unchanged at 6*d*. per hour for all time worked.

Worcester.—An Order fixing minimum and overtime rates of wages came into force on March 7, 1938 (i.e., the day following that on which the existing rates expired) and continues in operation until March 5, 1939 The minimum rates in the case of male workers of 21 years of age and over are 33*s*. (as formerly) per week of 43 hours in the week in which Good Friday falls, and 52 hours in any other week in summer; 39½ hours in the week in which Christmas Day falls and 48 hours in any other week in winter, with overtime unchanged at 9*d*. per hour. In the case of female workers of 18 years of age and over the minimum rates are unchanged at 5*d*. per hour with overtime on Sundays and in excess of 8 hours on any other day at 5¾*d*. per hour

Glamorgan.—An Order fixing minimum and overtime rates of wages for workers (other than male workers employed wholly or mainly in forestry) came into force on March 2, 1938 (i e , the day following that on which the existing rates expired) and continues in operation until March 1, 1939 The minimum rates in the case of male workers of 21 years of age and over employed wholly or mainly as stockmen, cattlemen, cowmen, horsemen, shepherds or bailiffs are 40*s* (instead of 38*s*.) per week of 60 hours with overtime unchanged at 10*d* per hour and in the case of other male workers of 21 years of age and over 36*s* (instead of 34*s* 6*d*) per week of 52 hours in summer and 48 hours in winter with overtime unchanged at 9*d* per hour on weekdays and 10*d*. per hour on Sundays In the case of female workers of 18 years of age and over the minimum rate remains unchanged at 6*d* per hour with overtime rates also unchanged at 7*d* per hour on weekdays and 7½*d*. per hour on Sundays.

Enforcement of Minimum Rates of Wages—During the month ending March 7, 1938, legal proceedings were taken against six employers for failure to pay the minimum rates of wages fixed by the Orders of the Agricultural Wages Board Particulars of the cases follow —

Committee Area	Court	Fines Imposed	Costs Allowed	Arrears of Wages ordered	No of workers involved
		£ s. d	£ s. d	£ s. d.	
Carmarthen	Whitland	0 10 0	—	15 9 5	1
Essex ..	Colchester	1 10 0	2 5 0	29 5 0	3
Somerset ..	Temple Cloud	1 0 0	—	11 1 9	1
Suffolk ..	Ixworth ..	30 0 0	—	41 11 11	1
Yorks (N.R.)	Whitby .	5 0 0	1 10 0	2 10 0	1
Yorks (W.R)	Bradford .	(A)	0 10 0	11 10 0	1
	Totals ..	£38 0 0	4 5 0	111 8 1	8

(A) = Dismissed under the "Probation of Offenders Act."

FOOT-AND-MOUTH DISEASE

Foot-and-Mouth Disease.—Since the last issue of the *Journal* went to press ten further outbreaks of foot-and-mouth disease were confirmed up to March 20. Three of these occurred at Wedmore in the Somerset Infected Area and three at East Christchurch in the Hampshire and Dorset Infected Area.

An outbreak that was confirmed at St. Mary in the Marsh, Kent, on February 19, necessitated the imposition of Infected Area Restrictions on an area extending for approximately 15 miles around the infected place. A further outbreak occurred in this area at Kingsnorth on February 23. Another outbreak, at Boughton Malherbe, on February 26, necessitated an extension of the Infected Area. As, however, no further outbreak occurred, the area was released from restrictions on March 20.

The only area subject to foot-and-mouth disease restrictions at the time of going to press is one of approximately five miles radius around East Christchurch, Hampshire. If no further outbreak occurs in this area, it will be released from restrictions on March 31.

SOME ADDITIONS TO THE LIBRARY

Agriculture, General and Miscellaneous

Whitaker, J., and Sons (Editors and Publishers)—The Reference Catalogue of Current Literature. (lxxii + 1046 + 1429 pp.) London, 1938, £3.

Mercer, S. P.—Farm and Garden Seeds. (205 pp. + 14 plates.) London: Crosby Lockwood, 1938, 10s. 6d.

Galloway, L. D., and Burgess, R. Applied Mycology and Bacteriology. (ix + 186 pp.) London: Leonard Hill, 1937, 10s.

Hedges, C. C., and Brayton, H. R.—Laboratory Manual of Agricultural Chemistry. (x + 74 pp.) London: D. Appleton-Century Co., 1938, 4s.

Jensen, E.—Danish Agriculture: Its Economic Development. A Description and Economic Analysis Centering on the Free Trade Epoch, 1870–1930. (417 pp. + 1 map and 2 tables). Copenhagen: J. H. Schultz Forlag, 1937, \$3.75.

Millard, P. W.—The Law Relating to Tithes and Payments in lieu thereof. (Third Edn.) (xli + 423 + li pp.) London: Butterworth & Co., 1938, 15s.

Snedecor, G. W.—Statistical Methods Applied to Experiments in Agriculture and Biology. (xiii + 341 pp.) Ames: Collegiate Press, 1937, \$3.75.

Riches, Naomi.—The Agricultural Revolution in Norfolk. (ix + 194 pp.) Chapel Hill: University of North Carolina Press, 1937, \$2.50.

Jennings, W. Ivor. The Law of Public Health, 1936. (cxii + 791 pp.) London: Charles Knight & Co., 1936, 42s. 6d.

Hempsall, W. Herrod.—Bee-keeping New and Old. Described with Pen and Camera. Vol. II. (pp. 773–1842 + 1 plate and 1 chart.) London: The British Bee Journal, 1937, 35*s*.

Agricultural Economics

Clapham, J. H.—An Economic History of Modern Britain. Vol. III. Machines and National Rivalries, 1887–1914. With an Epilogue, 1914–1929. (577 pp.) Cambridge at the University Press, 1938, 25*s*.

Lawley, F. E.—The Growth of Collective Economy. Vol. I. (xx + 524 pp.) Vol. II. (xv + 485 pp.) London: P. S. King & Son, 1938, 35*s*. (2 Vols.)

Jeffcock, W. P.—Agricultural Politics, 1915–1935. Being a History of the Central Chamber of Agriculture during that period. (v + 140 pp.) Ipswich. W. H. Harrison & Sons, 1937, 5*s*. 6*d*.

Nourse, E. G., Davis, J. S., and Black, J. D.—Three Years of the Agricultural Adjustment Administration. (xiv + 589 pp.) Washington: The Brookings Institution, 1937, $3.50.

Bowley, A. L.—Wages and Income in the United Kingdom since 1860. (xix + 151 pp.) Cambridge at the University Press, 1937, 8*s* 6*d*.

Van der Post, A. P.—Economics of Agriculture. (xxvii + 603 pp.) Johannesburg. Central News Agency, 1937, 25*s*.

Agricultural Marketing

Malott, D. W.—Problems in Agricultural Marketing (xiii + 40[illegible] pp.) New York and London McGraw-Hill Publishing Co., 1938, 18*s*

Bakken, H. H., and Schaars, M. A.—The Economics of Co-operative Marketing. (xiii – 583 pp.) New York and London McGraw-Hill Publishing Co., 1937, 24*s*.

Husain, H.—Agricultural Marketing in Northern India. (342 pp.) London Allen and Unwin, 1937, 15*s*

Smith, H.—Retail Distribution: A Critical Analysis (vi + 17[illegible] pp.) Oxford University Press. London: Humphrey Milford, 1937, 7*s* 6*d*

Botany and Plant Physiology

Gillespie, J.—An Introduction to Economic Botany. (96 pp.) London Gollancz, 1937, 1*s* 6*d*.

Wright, E. C. B.—General Plant Physiology. (539 pp.) London: Williams and Norgate, 1937, 15*s*.

Crops

The Grass Driers' Association.—Feeding Artificially Dried Grass by *S. J. Watson.* (68 pp.) London: Fertiliser and Feeding Stuffs Journal, 1938, 2*s*.

Fourth International Grassland Congress.—Report containing full texts of all papers delivered to the Congress at Aberystwyth on July 15, 16 and 17, 1937. (President: Professor R. G. Stapledon.) (xxxiv + 486 pp.) Aberystwyth: 1937, £2.

Bridges, A., and Weeks, E. P.—Mechanized Corn Growing. A Record of Three Years' Experience, 1934–1936. (68 pp.) Oxford. Agricultural Economics Research Institute, 1937, 2*s*. 6*d*.

Some Additions to the Library

Dairying and Dairy Products

Smith, B. L., and Whitby, H.—Milk Marketing Before and After Organisation. A Study in Central Somerset. (56 pp) Oxford: The Agricultural Economics Research Institute, 1937, 2*s*.

Board of Trade.—Report by the Food Council to the President of the Board of Trade on Costs and Profits of Retail Milk Distribution in Great Britain. (36 pp. + 1 chart) London: H.M Stationery Office, 1937, 9*d*.

Oxford Agricultural Economics Research Institute.—Milk Investigation Scheme:—Costs of Milk Production in England and Wales, Interim Report No. 1. November 1st, 1934, to September 30th, 1935 (87 pp) Oxford, 1937, 2*s* 6*d*

Winton, A H., and Winton, Kate B.—The Structure and Composition of Foods. Volume III Milk (including Human), Butter, Cheese, Ice Cream, Eggs, Meat, Meat Extracts, Gelatin, Animal Fats, Poultry, Fish, Shellfish (xxv + 524 pp.) New York John Wiley & Sons; London Chapman and Hall, 1937, 40*s*

Horticulture and Fruit Culture

Brett, W.—Vegetable Growing For Home Use and Sale (192 pp.) London C Arthur Pearson, 1937, 1*s* 6*d*

Brett, W.—The Lawn. How to Make and Maintain It (144 pp) London C Arthur Pearson, 1937, 1*s* 6*d*

Irish Free State Department of Agriculture Potato Growing for Seed Purposes by *W. D Davidson* (236 pp + 63 plates) Dublin. The Stationery Office, 1937, 2*s* 6*d*

Macself, A J—The Chrysanthemum Grower's Treasury. (Third edition) (290 pp. + 33 plates) London W H. and L Collingridge, 1937, 5*s*

Hoare, A. H—Commercial Apple Growing (245 pp + 16 plates) London Martin Hopkinson, 1937, 10*s*

Live Stock

Forman, C—Pig Breeding and Feeding The Breeding and Feeding of English Swine in an English Climate for the English Market. (173 pp.) London Faber and Faber, 1937, 6*s*

Plant Diseases and Pests

Smith, K—A Test-book of Plant Virus Diseases. (x + 615 pp + 1 plate.) London. J. and A Churchill, 1937, 21*s*.

Heath, F. D—Introduction to Plant Pathology. (xi + 579 pp) *London* McGraw Hill, 1937, 24*s*

Soils and Fertilizers

Robinson, G W.—Mother Earth, being Letters on Soil addressed to Professor *R. G. Stapledon*. (viii + 202 pp. + 2 maps + 1 plate.) London. Thomas Murby & Co, 1937, 5*s*. 6*d*.

Bear, F. E.—Theory and Practice in the Use of Fertilizers. (Second edition.) (360 pp. + 1 plate.) New York: Wiley; London: Chapman and Hall, 1938, 20*s*

NOTICES OF BOOKS

A Laboratory Handbook for Dietetics. By Mary Swartz Rose, Ph.D. 4th edition. Pp. xi + 322, and 30 Tables. (London: Macmillan & Co., Ltd. 1937. Price 12*s*. 6*d*.)

As indicated in the preface, the purpose of this book is to explain the problems involved in the calculation of food values and food requirements, and to furnish up-to-date reference tables of analytical data on the composition of food materials The name of the author is sufficient guarantee of painstaking and careful work, and, as was to be expected, she has admirably succeeded in her task.

During the eight years since the third edition appeared rapid advances have been made in our knowledge both as regards the composition and nutritive efficiency of foodstuffs, and the human requirements of essential constituents such as the mineral elements and vitamins. The fact that the reference tables occupy over 200 pages of the book gives some idea of the ground covered . yet our knowledge is still far from complete. The use of the plus and minus sign to denote the vitamin potency of a food is disconcertingly frequent. This, however, is not the author's fault, but that of the investigator who provides her raw material, and who too often lays emphasis in the wrong direction Why, for example, do we know so little regarding the vitamin A content of such a common food as the herring and yet find it carefully worked out for dock leaves and dandelions? There is urgent need, too, for authoritative tables of vitamin data expressed in International units Vitamin values are here given in biological units " because the values have been determined in this way, and there is not yet agreement as to the relationship of all these to the International units which are now coming into use."

Nevertheless, in view of the extensive, yet scattered, literature on the composition of foods, labour-saving compilations of this kind are indispensable, not only to the practical dietician for whom the book is primarily intended, but to the growing number of nutrition research workers all over the world whose studies involve the evaluation of dietaries from a health point of view.

Practical Plant Breeding. By W J. Lawrence, F L S With a Foreword by Sir Daniel Hall, K C B , F R S. Pp. 155. (George Allen & Unwin, 1937 Price 5*s* 6*d*.)

It is notoriously difficult for the scientist to present the results of research in a form readily intelligible to the lay mind, and this is increasingly so when the subject is one necessitating the use of a completely new terminology. One turns then with considerable curiosity to this little book by an author who has strong initial practical sympathies amplified by association with fundamental research, to study his manner of presenting an intricate subject The result is wholly admirable, and fulfils the author's object in a remarkably concise manner. The latter feature alone is ample testimony to his grasp of a widely-ramifying subject.

With much of the subject matter of the first half of the book the practical man is now more or less familiar, but the mechanism of Inheritance presented in Chapter V introduces him to an entirely new aspect of his subject. The reader is here launched into what the author describes as a " world of genes," from the study of which there is no escape, for " gene mutation is the fundamental process by which evolution proceeds."

One of the most perplexing problems of breeding, common to horticultural and agricultural plants alike, is sterility. The various conditions

operating to produce sterility are described lucidly. In a book of this size it is obviously impossible to develop every aspect as comprehensively as a more advanced reader might desire. Nevertheless, one leaves the question of sterility regretting that the reasons attaching to the value of bud-stage pollination in self- and cross-incompatible plants are not commented upon, and that no mention is made of the possibility of securing fully self-fertile forms in these elusive classes of plants.

The portion of the book of most direct interest to the practical man is the chapter devoted to Methods of Plant Improvement; this cannot fail to stimulate a more scientific outlook, whilst its immediate value must be that of a deterrent to the pursuit of projects which by their very nature are doomed to failure.

It is interesting to note the author's counsel that the breeder "should be observant"—an admonition defining the essence of success, for without a keen eye for differences the highest scientific qualification can ensure no more than a limited measure of success

There can, of course, be no standard of ultimate perfection in breeding, and one closes this most interesting book with the feeling that the author has reported progress in a never-ending pursuit.

Industrial Fibres, 1937: A Summary of Figures of Production, Trade and Consumption relating to Cotton, Wool, Silk, Flax, Jute, Hemp and Rayon. (Obtainable from His Majesty's Stationery Office, Adastral House, Kingsway, W.C.2 Price 2*s.* 6*d*; post free 2*s.* 9*d.*)

This annual review by the Imperial Economic Committee shows that during the 1936–37 season cotton broke all previous records for production and consumption. This fibre provides approximately three-quarters of the raw materials required for the manufacture of clothing fabrics, and its production in 1936–37 reached 15,000 million lb Rayon and staple fibre continued their remarkable advance, the estimated output of some 1,300 million lb. last season comparing with about 550 million lb. five years ago. World production of wool amounted to 3,900 million lb. (greasy basis) in 1936–37, the highest figure since 1929–30, and the active demand by consuming countries left very small stocks in the primary markets at the close of the season. Of all industrial fibres, silk alone failed to share in the general expansion in world production and consumption.

Half the entire output of raw cotton, wool and jute, and the major part of the production of raw silk and hemp fibres, enter the channels of international trade The direction of trade has undergone important changes in recent years, largely owing to financial and economic difficulties and the efforts made to secure national self-sufficiency. The Soviet Union, Germany and Italy have curtailed their imports, the raw materials of the national industries being met by increased domestic production of synthetic and natural fibres. The French textile industry has been handicapped by prolonged deflation and increasing cost of labour and materials. British retained imports of all industrial fibres, however, showed a considerable increase in 1936 as compared with recent years. Japan supplanted the United States as chief producer of rayon and maintained its position as the principal market for cotton exports, but Japanese wool imports were reduced. The United States, the Soviet Union and India are the largest producers and consumers of cotton, flax and jute respectively. In each instance consumption in 1936 showed a large increase.

As the review states, the extent to which the increased use of rayon and staple fibre accounts for reduction in the consumption of natural fibres is problematical in most countries. In Britain and the

United States the expansion of rayon and staple fibre output does not appear to have reduced the consumption of other fibres. An increase in the use of staple fibre in the wool and cotton industries of the United States is reported. Concentration on the production of staple fibre in Germany and Italy has been accompanied by a considerable diminution in imports of cotton and wool. In Japan rayon and staple fibre are being used in place of cotton for the manufacture of native garments, and it is reported that some attempt may be made to mix staple fibre with wool.

Fruit Supplies in 1936. (Published for the Imperial Economic Committee by H M Stationery Office Pp 106 Price *2s. 6d.*; post free, *2s. 9d*)

The seventh annual issue in the series of reviews of "Fruit Supplies" in the United Kingdom follows the same lines as previous volumes and shows that the consumption of raw fruit in this country has increased very considerably in recent years The total net supplies available for home consumption averaged, in the last three years, 1,840 thousand tons, whilst ten years ago the corresponding figure was approximately 1,470 thousand tons In 1936 the average consumption per head was about 89 lb, a figure well above that for the previous year though somewhat short of the record figure (96 lb) for 1934

Of the total supplies 38 per cent came from Empire sources, 32 per cent. from foreign countries and 30 per cent from home production. In this country a year of good fruit crops followed the poor 1935 season. The total quantity of raw fruit imported in 1936 fell by 11 per cent from the previous year's record total of 1,477 thousand tons Supplies from Empire countries declined less heavily than foreign supplies In each of the past two years Empire countries have found the United Kingdom a market for more fruit than was imported from all countries before 1914, and more than 70 per cent of our imports of apples and bananas now come from the Empire

Three fruits—oranges, apples and bananas—normally account for about 80 per cent of the total imports, and four others—lemons, grapefruit, pears and grapes—for a further 15 per cent With the single excepton of bananas, the imports of which show steady progress and in 1936 reached a new record, a smaller quantity of each kind of fruit was imported last year, the decline being especially marked with apples (22 per cent) grapes (24 per cent) and lemons (26 per cent) At the same time imports of grapes, plums, peaches, lemons and pineapples from Empire countries all reached new high levels, whilst pears, oranges and grapefruit were higher than in any year other than 1935. Supplies from South Africa showed further expansion and constituted a new record Imports from both Australia and New Zealand were heavier than in the previous year, but there were reductions in consignments from Canada, the British West Indies and Palestine

This review is not confined entirely to fruit, but deals also with vegetables, bulbs and flowers It provides useful statistics of the production of fruit and glasshouse crops in the United Kingdom, seasonal reviews of fruit shipments from the main sources of supply, schedules of import duties and notes on imports of raw fruit into certain other countries.

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NOTES FOR THE MONTH

The Value of the Agricultural Output

In the issue of the *Agricultural Market Report* for March 12, 1937, it was explained that the special inquiries undertaken by the Ministry in 1930-31 in connexion with the census of agricultural production enabled an estimate to be made of the total value of the output of agricultural and horticultural produce in England and Wales in that year. It was also indicated that from this starting point, and with additional information collected in subsequent years by special inquiries regarding individual commodities, it was possible to construct a series of annual estimates of the value of the output. Such a series for the years 1930-31 to 1935-36 inclusive was published in the issue of the *Report* for March 12, 1937, when it was stated that some further revision would probably be necessary as a result of inquiries then proceeding or projected.

Special inquiries have now been completed in connexion with the output of glasshouse produce, fruit, and milk and milk products, preliminary particulars of which have appeared in issues of this JOURNAL. In the estimates detailed below the value of the output for 1936-37 has been computed in the light of the results of these recent inquiries, and the estimates for previous years (subsequent to 1930-31) have been re-calculated where necessary.

The total value of the agricultural and horticultural output in England and Wales is estimated to have been £220,600,000 in 1936-37, an increase of £14,700,000 (nearly 7 per cent.) compared with the revised estimate of £205,900,000 for 1935-36, or of £17,900,000 (nearly 9 per cent.) compared with the estimate for 1930-31. The combined value of the output of live stock and livestock products, which has increased continuously since 1931-32, amounted in 1936-37 to £148,300,000, an increase of £6,900,000 as compared with 1935-36. The

ESTIMATED VALUE OF THE OUTPUT* OF AGRICULTURAL AND HORTICULTURAL PRODUCE IN ENGLAND AND WALES DURING EACH OF THE SEVEN YEARS 1930–31 TO 1936–37

Commodity	1930–1931	1931–1932	1932–1933	1933–1934	1934–1935	1935–1936	1936–1937
	Mill. £	Mill. £	Mill. £	Mill. £	Mill. £	Mill. £	Mill. £
Live Stock and Livestock Products:—							
Cattle and Calves†	29·9	26·9	23·6	23·5	25·1	25·5	27·0
Sheep and Lambs ..	15·6	14·3	14·4	16·9	15·9	15·0	15·6
Pigs	19·5	17·0	18·4	20·3	21·0	22·6	25·4
Milk and Dairy Produce	55·0	46·8	49·3	52·1	52·9	54·1	55·8
Poultry	5·3	5·3	5·4	5·8	6·2	6·0	5·5
Eggs	15·7	14·8	15·4	15·5	15·3	16·3	15·9
Wool	1·3	1·2	1·8	1·8	1·8	1·9	3·1
Total	142·3	126·3	128·3	135·9	138·2	141·4	148·3
Farm Crops:—‡							
Wheat†	3·6	3·2	3·3	4·0	4·7	5·2	6·7
Barley	3·9	4·1	3·5	3·7	3·9	3·5	4·0
Oats	1·6	1·8	1·5	1·4	1·5	1·4	1·7
Mixed Corn, Rye, Beans and Peas ..	0·7	0·7	0·7	0·7	0·7	0·5	0·6
Potatoes	11·7	15·9	9·1	8·5	11·6	13·8	14·5
Sugar-Beet ..	6·8	3·1	4·2	5·8	7·2	5·7	5·9
Hops .. .	0·9	0·9	1·6	3·1	2·2	2·1	2·1
Hay	3·0	2·4	1·7	2·5	3·2	2·9	3·2
Straw	0·8	0·8	0·7	0·6	0·7	0·7	0·9
Mustard Seed ..	0·2	0·1	0·1	0·1	0·2	0·2	0·2
Total	33·2	33·0	26·4	30·4	35·9	36·0	39·8
Fruit and Vegetables:—							
Fruit	7·8	5·6	7·1	8·2	10·5	5·0	8·3
Vegetables	12·3	15·1	12·9	16·8	13·3	15·0	15·4
Total	20·1	20·7	20·0	25·0	23·8	20·0	23·7
Glasshouse Produce, Flowers grown in the open and nursery stock ..	7·1	7·0	7·8	7·7	8·1	8·5	8·8
Total of above items	202·7	187·0	182·5	199·0	206·0	205·9	220·6

* The output represents the estimated sales of produce by farmers for the use of the non-farming community, together with the estimated quantity of home-grown produce consumed in farm households.

† Not including the Cattle Subsidy or deficiency payments under the Wheat Act which, in respect of England and Wales, have been as follows.—

	Cattle	Wheat	Total
	£	£	£
1932–33	—	4,270,000	4,270,000
1933–34	—	6,750,000	6,750,000
1934–35	1,910,000	6,400,000	8,310,000
1935–36	2,730,000	5,230,000	7,960,000
1936–37	2,830,000	1,260,000	4,090,000

‡ The proportions of the various farm crops taken as forming part of the output in 1931–32 and later years have been assumed to be the same as those ascertained for the Census year 1930–31.

combined value of the output of farm crops, which in 1935-36 was practically the same as in 1934-35, rose by £3,800,000 in 1936-37 to £39,800,000 and was £6,600,000 greater than in 1930-31. The value of the fruit crop recovered from the low figure of £5,000,000 in 1935-36 to £8,300,000 in 1936-37, while the value of the output of vegetables, glasshouse produce, flowers and nursery stock also increased slightly in total. Details are given in the table opposite.

From an examination of the changes in individual items, it will be seen that increases on the year were recorded for the value of the output of each of the items in the live stock and livestock products group except poultry and eggs. These showed reductions of 8 and 2 per cent. respectively as against increases of 6 per cent. for cattle and calves, 4 per cent. for sheep and lambs, 12 per cent. for pigs, 3 per cent. for milk and dairy produce and 63 per cent. for wool. In farm crops, increases were also recorded for nearly all the items. Values of the output of corn crops, principally wheat, increased by nearly 23 per cent., of potatoes by 5 per cent., of sugar-beet by nearly 4 per cent. and of hay and straw by 10 and nearly 29 per cent. respectively.

The changes referred to in the preceding paragraphs are the result of changes both in quantity and price. In order to obtain an approximate indication of the changes in the volume of production, the output in each of the years subsequent to 1930-31 has been revalued at the prices ruling in 1930-31, and the results of these calculations are set out in the table below. Owing to the lack of adequate quantitative data relating to nursery stock, flowers grown in the open, and to some descriptions of glasshouse produce, the group comprising these products has been omitted from this calculation throughout.

VALUE OF OUTPUT AT FIXED PRICES

Group	1930–1931	1931–1932	1932–1933	1933–1934	1934–1935	1935–1936	1936–1937
	(a) Value of Output at 1930–31 average prices in Million £						
Live Stock and Live-stock Products ..	142·3	148·2	157·4	162·4	163·5	169·2	166·7
Farm Crops	33·2	28·3	33·2	36·7	39·3	34·9	33·7
Fruit and Vegetables*	20·1	18·8	19·6	21·8	28·0	15·4	27·7
Total	195·6	195·3	210·2	220·9	230·8	219·5	228·1
	(b) Index Numbers—1930-31 = 100.						
Live Stock and Live-stock Products ..	100	104	111	114	115	119	117
Farm Crops	100	85	100	110	118	105	102
Fruit and Vegetables*	100	94	98	109	140	77	138
Total	100	100	107	113	118	112	117

* Excluding fruit and vegetables grown under glass

Calculated on this basis the volume of the output in 1936-37 was 17 per cent. larger than in 1930-31 as against the corresponding increases of 12 per cent. in 1935-36 and 18 per cent. in 1934-35. The volume of output in the live stock and livestock products group has risen continuously from 1930-31 to 1935-36, but in 1936-37 the output of most of the items in the group was slightly less than in the preceding year and the total is rather smaller. There was a slight decline also in the volume of the output in the farm crops group, which is mainly accounted for by a somewhat smaller output of wheat, oats and potatoes. The fruit and vegetable group showed a very considerable increase in 1936-37 as compared with 1935-36 and almost recovered to the 1934-35 figure. The 1935 orchard fruit crop was much below normal in quantity, whereas those in 1934 and 1936 were above average.

When measured by means of index numbers, taking the year 1930-31 as 100, it will be observed that the livestock group shows a comparatively steady increase over the seven years, whereas in the case of the farm crop and fruit and vegetable groups, which are appreciably influenced by weather conditions, there is considerable variation. For farm crops the worst year in the series was 1931-32 and for 1936-37 the index was only 2 points above that in 1930-31 and 1932-33.

Potato Synonyms

The following note has been communicated by the National Institute of Agricultural Botany:—

The report of the work of the Potato Synonym Committee of the National Institute of Agricultural Botany for 1937 shows that as a result of their activities the offering of synonyms in the largest seedsmen's catalogues has now been practically eliminated. The Committee wish to acknowledge the co-operation of the seed trade which has helped to produce this healthy state of affairs.

Two synonyms, however, namely Cherub and Lord Allendale, which were found to be identical with Duke of York and King Edward VII (red type) respectively, when grown at Ormskirk last year, are again being offered for sale this year. Apart from these, Midlothian Early, Sir John Llewelyn and Factor are still found in some catalogues. It is hoped that seedsmen will make it clear that these are identical with Duke of York, Eclipse and Up-to-Date, for the use of alternative names, however well known, can only lead to confusion.

The Committee are to be congratulated on the outcome of the work that they have carried out for so many years.

English-Speaking Union Agricultural Scholarship

The Norfolk Branch of the English-Speaking Union has awarded a special scholarship of £100 to Mr. F. Rayns, O.B.E., M.A., the Director of the Norfolk Agricultural Station, Sprowston, Norwich, to enable him to visit the United States and Canada.

Mr. Rayns has travelled extensively in Europe for the purpose of making a survey of Continental beet growing for the Ministry of Agriculture and the beet sugar factories. As Director of Agricultural Education for Norfolk he is responsible for organizing facilities for advisory work on farms and for agricultural education generally in the county.

Mr. Rayns' special interest is with all matters connected with the sugar-beet industry, and during his visit to America the English-Speaking Union of the United States will arrange a series of appointments for him, enabling him to meet and discuss problems connected with this industry. Mr. Rayns will also see something of the latest experiments in arable agriculture, and animal husbandry, and will visit representative research stations.

Mr. Rayns throughout his visit to the United States and Canada will receive hospitality from members of the American organization in their own homes and from American Universities where there are special departments for agricultural study and research.

Popularity of Different Varieties of Potatoes

The statements published annually by the Department of Agriculture for Scotland of the acreages under potatoes provide an indication of the popularity of different varieties in Great Britain, as a large proportion of the crops raised in Scotland is destined for use as seed.

The following comparison of these reports over the five years 1933-37 may be of interest to English growers:—

Among the *First Earlies*, Epicure is still the most widely grown and shows no great fluctuation in acreage; the acreage under Sharpe's Express in 1937 was not much smaller than in 1935 and 1936, but the 1937 figure was slightly smaller than of losing its popularity; Eclipse showed an increased acreage in 1935 and 1936 but the 1937 figure was slightly smaller than that for 1933; the first early variety that has most increased its popularity during the 5 years is Arran Pilot,* the acreage under which has increased progressively from 63 in 1933 to 1,077 in 1937.

In the *Second Early* class, Great Scott* remains by far the most popular, although the 1937 acreage is some 2,000 less than that of 1933; British Queen shows a somewhat smaller decline; Arran Luxury* has advanced from 130 acres in 1933 to 220 in 1937.

Amongst the *Maincrop* varieties, Kerr's Pink* remains the most popular, although the 1937 acreage is nearly 20,000 less than that of 1933; Majestic* increased progressively from 11,116 acres in 1933 to 17,103 in 1937 and overtook King Edward VII (including its coloured variation), which declined from 14,188 in 1933 to 12,607 in 1937 although it was more widely grown in the intervening years; Golden Wonder* shows no significant change; Arran Banner* maintains the position reached in 1934 when it showed an increase of 1,000 acres; the most noticeable new Maincrop varieties are Doon Star,* which increased from 216 acres in 1933 to 4,438 in 1937, and Redskin,* which, with 1,358 acres, appeared in the lists for the first time in 1937.

* An approved Immune Variety.

Nutritive Value of Milk for School Children

The first of the reports on the work undertaken under the direction of the Milk Nutrition Committee dealt with the effect of commercial pasteurization on the nutritive value of milk as determined by laboratory experiments, including experiments on rats. A note summarizing the results of this investigation was included in the issue of this JOURNAL for June, 1937, (p. 201).

The Milk in Schools Scheme was launched a few months before the Milk Nutrition Committee was set up, and the Committee felt it would be desirable to investigate what effects the quantities of milk normally consumed under the Milk in Schools Scheme (namely, one-third of a pint and, less frequently, two-thirds of a pint per head daily) had on the growth and health of the children participating in the Scheme.

A report has now been issued* describing such an investigation and which covered over 8,000 children in elementary schools in Luton, Wolverhampton, Burton-on-Trent, Renfrewshire and Huddersfield.

The children were divided into four groups as follows:—

GROUP I. 2,000 children to act as "controls" who did not receive any supplement of milk at school, but got biscuits instead.

GROUP II. 2,000 children who received one-third of a pint pasteurized milk per day.

GROUP III. 2,000 children who received two-thirds of a pint pasteurized milk per day.

GROUP IV. 2,000 children who received two-thirds of a pint of raw milk per day.

The investigation lasted for a year at each centre. The children were weighed and measured at the beginning and end of the investigation, as well as at two intermediate examinations, by qualified medical investigators. In addition, at each of the four examinations, the investigators made a complete assessment of the general clinical condition of each child under such headings as posture, expression, complexion, teeth, and eyes.

The analysis of the data obtained in the investigation proved to be a task of some magnitude. The present report

* *Milk and Nutrition: New Experiments reported to the Milk Nutrition Committee. Part II.* The Effects of Dietary Supplements of Pasteurised and Raw Milk on the Growth and Health of School Children (Interim Report). Pp. 34 (to be purchased directly from the National Institute for Research in Dairying, Shinfield, Reading. 1938. Price 1*s.* 9*d.* post free).

deals with an analysis of the measurements of height and weight at the beginning and end of the survey for those children who had been attending school regularly and who were present at all four medical examinations. A final report, dealing with the data as a whole, is to be issued later.

The chief conclusions that the report draws from the investigation are as follows:—

Taking all ages and all areas together, the average increase in height and weight over the year of enquiry rises as we pass from the groups of children whose supplement was biscuits to the groups whose supplement was one-third of a pint of milk, and again from the latter to the groups whose supplement was two-thirds of a pint of milk.

The absolute differences between the average increments of height and weight of the groups with milk as a supplement and the groups with biscuits as a supplement are not, however, very large. Comparing the extreme groups, those with biscuits and those with two-thirds of a pint of milk, the differences do not amount to more than 0.1 in. in height during the year or to more than two-thirds of a lb. to one lb. in weight.

The increments produced by milk in this investigation are, therefore, smaller than those obtained in former experiments of this type, such as those of Sir John Orr, Clarke, Leighton and McKinley. The most probable explanation of this is that the quantities of milk fed as supplements in the previous experiments varied from three-quarters of a pint to 1¼ pints per head daily, whereas in this experiment they were one-third and two-thirds of a pint only, being the quantities normally consumed under the Milk in Schools Scheme. There is also evidence indicating that the basic diet of the children in the present investigation was of higher nutritive value than that of the children in previous experiments, thus allowing a smaller margin for the supplements of milk to demonstrate their effect.

During the year, boys with biscuits as a supplement increased their initial height by 4.16 per cent. and their initial weight by 10.87 per cent., while boys with two-thirds of a pint of milk increased their height by about 4.4 per cent. and their weight by 12 per cent. Girls with biscuits as a supplement increased their initial height by 4.66 per cent. and their initial weight by 12.75 per cent.; girls with two-thirds of a pint of milk increased their height by about 4.8 per cent. and their weight by about 14 per cent.

The average year's increment of those children whose supplement was two-thirds of a pint of milk expressed as a percentage of the average year's increment of the children whose supplement was biscuits, shows that the groups with the milk supplement gained 4-6 per cent. more in height during the year, and 9-10 per cent. more in weight than those with the biscuit supplement.

Comparisons of the growth increments in three different age groups, 5-7 years, 8-10 years and 11-14 years, show that at each age children with one-third of a pint of milk gained more in weight than those with biscuits, and probably—but rather less consistently—gained more in height. On the whole, children with two-thirds of a pint gained at each age more than those with one-third pint, again more persistently with weight than with height. The figures suggested that the excess gain of the group with milk over the gain of the group with biscuits was slightly greater at years 8-10 than at the higher or lower ages.

Examination of the differential gains in height and weight of children clinically assessed as (i) good or excellent, (ii) satisfactory or normal, (iii) poor or bad, led to the conclusion that, on the whole, children of each clinical grade with milk supplements showed higher rates of growth than children in the corresponding clinical grades with the biscuits supplement. There was no clear difference between the relative advantages shown by the children of the three clinical grades. The absolute gains tended to be greater for each feeding group amongst the children initially defined as well-nourished.

Whether comparisons be made of the increments of growth in the total of children or in sub-divisions by age, area, and clinical assessment, there is apparent no consistent difference in these increments between children whose supplement was two-thirds of a pint of pasteurized milk and children whose supplement was two-thirds of a pint of raw milk.

The report points out that the numerical values of the increments attributable to the larger supplements of milk were, however, so small, amounting to only about 0.1 in. for height, and two-thirds to one lb. in weight during the year, that it is very doubtful whether any slight differences between the nutritive values of raw and pasteurized milk in supplements of this amount could be revealed by measurements of height and weight.

An addendum states that since the original report went to

press, further results deserving of mention have come to hand. Those available show the differences between the chest and dynamometer-pull measurements for children of 8 years of age and over at the first and fourth medical examination. Ignoring age, sex and area differences, the results suggest that the milk supplements have led to increases in the mean chest girth and muscular strength of the children. The average increments in the milk-fed groups for all areas, both sexes and ages 8-14 years, combined, compared with the biscuit groups (taking the increment in the latter as 100) are as follows:—

Group	*Biscuits*	*⅓ pint Pasteurized*	*⅔ pint Pasteurized*	*⅔ pint Raw*
Chest	100	105·3	109·0	109·9
Pull	100	106·4	109·8	106·1

Weeds of Arable Land

The part played by weeds in farm economy has long been recognized by farmers, and the Ministry has repeatedly directed attention to the subject since the year 1900. It cannot but be of great value to farmers and gardeners to be in a position to recognize weeds, and to have a knowledge of their life history and habits. Such a knowledge of a given weed will at the outset often enable one to judge whether it is likely to cause serious trouble, and will largely indicate what type of protective and remedial measures may most successfully be adopted.

Since the Ministry's publication *Weeds of Arable Land* was first published in 1929, many changes in the methods of control and eradication of weeds have taken place, e.g., the introduction of the spraying of corn crops with sulphuric acid, and similar methods of control. A substantial revision of the book has therefore been made by the author, Mr. H. C. Long, I.S.O., B.Sc., and it is believed that the additional material included in the 2nd edition* will add greatly to its value.

General methods of control are given, and other preliminary chapters deal with losses caused by weeds, weeds in relation to soils, seed testing and the importance of clean seed, and the compulsory destruction of weeds. The main part of the volume deals individually with the arable-land weeds commonly found in this country and includes 102 illustrations in

* Bulletin No. 108, *Weeds of Arable Land.* Price 4*s.* (post free, 4*s.* 6*d.*). Obtainable through a bookseller or from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2.

line and half-tone. The species are classified under their Natural Orders; short descriptions sufficient for identification are supplied and methods of eradication or control indicated. There are also a glossary of botanical terms, a short list of useful references in English, and an index, the book extending to 215 pages. The volume is quarter bound in stout boards, with an art front cover illustrating field bindweed in colour.

National Institute of Agricultural Botany

The annual report of the National Institute of Agricultural Botany for the season 1936-37 is now available. It deals chiefly with cropping tests of the newer varieties of field crops. In all instances the crops are grown just as they would be by the farmer himself, and trials are often carried out on farmers' land as well as at the Institute's permanent centres.

A new white winter oat, S.147, produced by the Welsh Plant Breeding Station, has given good results and it is to be put on the market by the Institute this autumn. It stands much better than Grey Winter, and is hardier than Resistance. The grain is of good size and attractive in appearance and the variety is specially suited to soils of medium to good fertility.

A new variety of potato named Dunbar Rover was entered for trial at Ormskirk and was awarded a Lord Derby Gold Medal. It is a second early of excellent tuber shape and cooking quality, and gave a higher yield than King Edward.

The report contains notes on trials of a very large number of strains of these and other crops and should be of interest to all farmers. Copies may be obtained, free of charge, on application to the Secretary, National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

Progress of the Land Fertility Scheme

The number of applications for contribution under the Land Fertility Scheme received from occupiers of agricultural land in the United Kingdom now exceeds 142,000. The quantities of lime and basic slag in respect of which these applications have been made are approximately 868,000 tons of lime and 325,000 tons of basic slag.

Number of Pigs in England and Wales in March, 1938

The following statement shows the estimated numbers of pigs on farms exceeding one acre in England and Wales on

March 4, 1938, and gives corresponding figures for June, September and December, 1937.

	1937 June	1937 September	1937 December	1938 March
	000's	000's	000's	000's
Sows for Breeding .	455	472	448	453
Boars for Service ..	32	33	32	31
Other pigs				
Over 5 months ..	2,107	994	916	791
2—5 months ..		1,634	1,688	1,356
Under 2 months	1,038	1,223	830	1,104
Total	3,632	4,356	3,914	3,735

Particulars of the pig population were not obtained in March in any previous year and it is accordingly not possible to reach a conclusion as to the full significance of the latest figures. When figures for June 4 next become available and it is known what change has taken place over the year, the fluctuations revealed by successive quarterly enquiries will have added importance.

The estimates for March, 1938, are based on returns received from one quarter of the occupiers of agricultural holdings exceeding one acre, enquiry forms having been sent to one-third of all such occupiers. An enquiry based on such a sample not only has the advantage of lessening cost, but it is clear from a test made of the figures obtained that the sample is sufficient to form the basis for estimating with reasonable accuracy the total pig population of the country.

THE PRODUCTION OF ANEMONES FOR CUT BLOOM IN SOUTHERN FRANCE

D. MANNING,
Horticultural Superintendent, Devon C.C.,
AND
P. H. GREGORY*

The intensive production in France of cut flowers for market during the winter months extends over the Mediterranean coastal district from Toulon to Menton. The main lines of production consist of roses, carnations, mimosa, narcissus, stocks, arum lilies and anemones, while a very large quantity of *Asparagus plumosus* is grown for foliage. Further inland, there is also a large area around Grasse devoted to the cultivation of flowers for the manufacture of the multitudinous perfumes for which the town is famous.

A considerable proportion of the roses and carnations are grown under glass, but the majority of the greenhouses are temporary structures, and permanent houses are rare. Few of the glasshouses are heated, frost is uncommon and straw mats are laid on the glass as a protection on cold nights. Carnations and anemones are also grown under glass lights raised on pole and rail structures, as well as in the open ground.

An article in the January, 1938, number of this JOURNAL has described the remarkably rapid increase in the acreage devoted to anemones in the early flower districts of south-west England. The crop this season is estimated at about thirteen million bunches, but, in spite of these large quantities coming from the West Country, for anemones of the highest quality the markets have to rely upon the produce of the French Riviera. The mixture and clarity of colours in the French flowers are not considered to be any better than those of good anemones from English sources, but their virtue lies in their long sturdy stems and large flowers. They come in small quantities only, and in spite of the long journey are able to command higher prices than flowers of English origin. The industry in this country is still in its infancy, and cultural methods are by no means standardized.

It is interesting to note that, whereas the area under

* Research worker stationed at Seale-Hayne College under a scheme financed jointly by the Great Western Railway Co., through the West Cornwall Branch of the National Farmers' Union, and the Ministry of Agriculture and Fisheries, upon the recommendation of the Agricultural Research Council, to whom grateful acknowledgments are made.

anemones in south-western England increased from 50 acres in 1931 to over 400 acres in 1937, the cultivation of this flower crop on the Riviera steadily decreased during the same period. This decrease is apparently attributable to various factors—more attractive returns from other flower crops, such as roses and carnations; increasing difficulty in cultivating anemones owing to " soil exhaustion " or " soil sickness " and also the tariff on flowers consigned to English markets. The general tendency is towards specialization, and anemone growing is now mainly confined to the smaller mixed flower farms and the specialist anemone growers who concentrate upon this crop alone.

The area devoted to anemones on even the specialist holdings is comparatively small, capable of being intensively cultivated by hand by family labour and plots of over an acre are rarely seen. The finest crops are naturally found on the holdings where soil and situation have been proved to be most favourable, but, speaking generally, a large proportion of the crops on the mixed flower farms is only of medium quality.

Climate. A comparison of the climate of the Riviera with that of the south-west of England is necessary when the methods of cultivation employed in these two districts are under consideration.

The daily mean temperature of the air is about 10°F. higher at Nice than at Falmouth in summer, but this difference almost disappears in the winter months. In spite of this, the daily range between maximum and minimum temperatures during the winter is nearly twice as great at Nice as it is at Falmouth. Although the day temperatures are much higher at Nice, this is counteracted by the rapid radiation at night owing to the clear air and cloudless Mediterranean sky.

The rainfall is relatively high at Nice though it is still only 75 per cent. of the annual mean at Falmouth. In both districts the months of greatest rainfall are from October to January, but in the south of France the dry period in summer is much more pronounced.

Throughout the year the south of France enjoys considerably more sunshine than Cornwall or Devon and this is most marked during the winter months when figures show that Antibes has approximately twice as many hours of sunshine as Falmouth. It is also of passing interest to note that the days in winter are somewhat longer on the Riviera.

FIG. 1 Corm production Seedbed mulched with Pine Needles

FIG. 2 Raised flowering Beds showing Straw Mulch

To face page 118.

Fig. 3. Anemones under Glass Lights

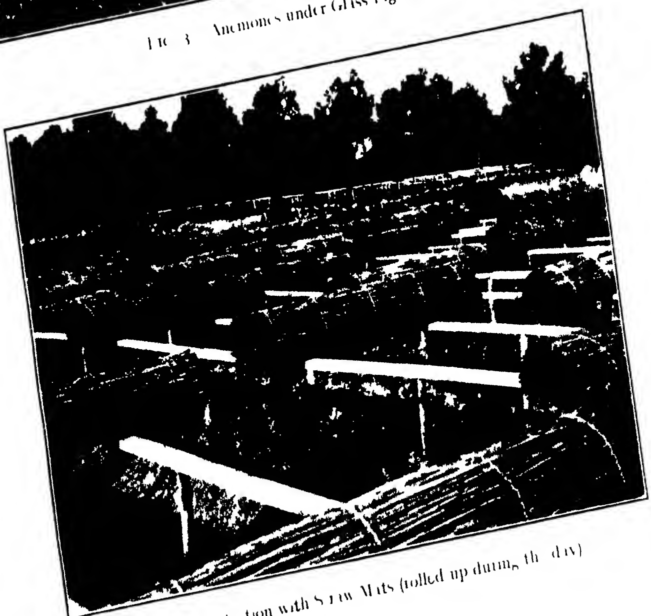


Fig. 4. Protection with Straw Mats (rolled up during the day)

Apart from the differences enumerated above, the two districts resemble each other in the possession of a mild equable winter climate.

Soils. The cultivation of anemones around Antibes is carried out on soils varying from a deep, retentive alluvial clay near the town to the free-working soils of the "terra rosa" type overlying the calcareous rock to be found on the foothills below the Alps.

It appears difficult to produce a good crop of anemones on the heavier types of clay even when the land is deeply dug and drained. It is only when the lighter, calcareous and porous soils are used that good crops of flowers are seen, and the highest quality bloom is found on the terraced slopes from 200 to 400 ft. above sea level. Here the crop flourishes on land formerly planted with olive trees that have been destroyed in recent years. Land being cheap it is possible to allow a rest of several years between successive crops of anemones, and it is the local belief that this rest is an essential factor in the successful cultivation of the crop. It is interesting to note that these alkaline clays, besides being rich in lime, contain a fair quantity of magnesium and a high proportion of potash, but have a remarkably low phosphate level.

Source of Corms. Anemones have been grown in southern France for many years, and the "de Caen" type is the strain most commonly cultivated. The scarlet variety "Hollandia" has been recently introduced to a small extent, but it is not much in favour in spite of its excellent colour as it lacks the vigour of the local strains. Most of the growers plant corms raised from seed saved from carefully selected plants growing in their own flowering beds. Some local trade is carried on in corms for planting and also in the selling of two-year-old corms to nursery firms for re-sale to private gardens.

Seed Saving. At the end of the main flowering season, in the latter part of April, all poor plants are rogued out of the beds. Most of the whites are discarded and also the splashed blue and white shades, as it is generally believed that the latter degenerate to whites. As the seed forms, the heads are collected in small muslin bags and hung under cover to ripen.

Seed Sowing. The seedbed, which is nearly always situated adjacent to the coming season's flowering beds, is dug several times during the summer; each digging is followed by

an artificial watering to induce weed germination. At the final digging the soil is finely pulverized and a bed about 5 ft. wide is raised 8-12 in. above the path; the seed is sown from mid-August to mid-September. The woolly nature of the seed makes it difficult to broadcast, but the grower overcomes this difficulty by placing it in a cane basket or " pad " and vigorously shaking this over the soil. When the seed is evenly distributed, the bed is covered with a light layer of burnt earth and finally mulched with clean pine needles to a depth of about an inch (Fig. 1). Much trouble is taken to obtain these pine needles, and this material is probably favoured owing to its freedom from weed seeds. The seed-beds are watered from time to time to ensure an even germination, and steps are taken to prevent damage by slugs until the plants develop about four leaves. Weeding is done by hand, the weeds being severed below ground with a small knife to avoid disturbing the anemone seedlings.

The seedbeds remain until the following May when, as the whites flower first, a certain amount of rogueing again takes place. The corms are then lifted, dried and stored for four or five weeks before being planted in the " flowering " position.

Planting the Corms. Although the opinion is held by some growers that better results are obtained from corms that have been " rested " or stored dry for twelve months, the general practice is to plant in the July following the lifting in May.

On a mixed flower farm, anemones usually follow carnations in the scheme of rotation. As the soil is trenched to a depth of nearly 2 ft. and generously manured for the carnation crop, it is only lightly dug over and a light dressing of organic manure incorporated before planting anemones. The specialist grower, however, prefers to break virgin soil or, failing this, a piece of ground that has been rested without a crop for several years. This land is deeply broken up during the winter with a four-tined " digger," much larger and heavier than the digger in common use in Devon and Cornwall. The worker stands in the bottom of the trench and throws the soil behind him—work that is generally done by contract at an agreed price per square metre. Little, if any, manure is applied as a basal dressing at digging time on virgin soil.

All anemones are grown on raised beds, about 4½-5 ft. wide,

the height varying between 6 in. and 1 ft. above the pathways. The raised bed probably has several advantages—drainage is improved, the soil is more easily warmed and, as weeding and flower picking is carried out from the paths, the soil is never trodden around the plants.

After the beds have been made up, the corms are planted as early in July as convenient, allowing four rows 16 in. apart to each bed. The corms are always placed in clumps, about 1 ft. apart in the rows, and the number in each clump varies from two to four according to size of corm. The corms planted range from 2 c.m. to 4 c.m. in circumference, all the smaller sizes being discarded or sold for growing on. When the plants appear above ground, they are evenly distributed throughout the bed in groups, 12 in. by 16 in. apart; this is a definite advantage from the point of view of weeding and surface cultivation.

The depth of planting varies considerably according to the texture of the soil; on the heavy alluvial clay the corms are placed about 1 in. below the surface, but on the more porous soils this depth is increased to nearly 3 in.

Cultivation. The planting period in July is usually followed by weeks of hot, almost rainless, weather, and artificial watering is necessary to start the corms into growth. After the corms are planted, the soil is covered with a mulch of clean wheaten straw to a depth of about 3 in. and the bed is then well watered (Fig. 2). This mulch serves several purposes—it prevents the soil from being beaten down hard by the periodical waterings and by the autumnal rains; the straw also helps to conserve moisture during the hot, dry summer months and so assists a steady growth of the plants; and during the flowering season it reduces the radiation of soil heat on winter nights under the cloudless skies.

Watering is a routine but highly skilled operation. Water is laid on to all flower farms and each holding is equipped with concrete storage tanks, underground mains, semi-permanent surface pipes and rubber hoses. The water supply is largely under the growers' control for the major part of the growing season. Over-watering in the winter may be detrimental to the plants, which apparently suffer much less from a cold spell if they are kept a little on the dry side.

Top Dressings. The French grower experiences the same difficulty that occurs in south-west England in maintaining the

uniform supply of nitrogen that seems necessary to the anemone plant during the long winter flowering season. Top dressings are applied to the beds whenever the change in the colour of the foliage towards a light green indicates a lack of available nitrogen. Sulphate of ammonia is the material generally used, and extreme care is taken to avoid any damage to the leaves of the plants. The manure is sown by hand when the foliage is quite dry, and any that falls on the leaves is brushed off with twigs or a bamboo cane. The first dressing is generally applied in early October, a second follows in January, and even a third dressing in early March may prove necessary. In some instances a complete fertilizer is employed for the second dressing and each application of manure is followed by a thorough watering to wash it down to the roots. There is no doubt that the bold, long-stemmed anemone flowers produced on these holdings come from sturdy plants with healthy foliage, which are the result of skilled attention on the part of the grower to the requirements of the plant.

Protection. Although the Antibes district enjoys approximately twice as many hours of winter sunshine as Falmouth, the cloudless skies at night permit such a rapid radiation of heat from the earth that some method of reducing this radiation has to be adopted. On the general flower farm where lights are in use for the temporary houses some of these are erected over the anemones on posts and rails about 4 ft. from the ground (Fig. 3). The usual practice, however, on all holdings is to use a type of straw mat, placed in position early in November, on a similar framework but only 2-2½ ft. from the ground. These mats are made of wheat straw or of reeds, and measure roughly 7 ft. long by 5 ft. wide (Fig. 4). They remain rolled up during the hours of sunlight and are unrolled every evening to conserve the warmth amongst the plants as much as possible. As the straw or reed of which they are made is steeped in a strong solution of copper sulphate, the mats last for several years. On many holdings a few beds are also grown without lights or mats and the seedbeds have no protection beyond the mulch already referred to. Apart from the alternating land and sea breezes, wind appears to be uncommon. Windbreaks, side screens or other methods of protection against damage by wind are considered by the anemone grower to be unnecessary.

Picking. Picking generally begins about the middle of

October; disbudding of the plants is not practised and flowers are marketed right from the start. The specialist grower sometimes beheads the flowers in autumn when stems are short and there is little demand for second-grade blooms. All picking takes place from the paths, care being taken to avoid treading on the beds; the flower stems are cut below ground with a small knife. The flowers are allowed to develop rather more than is usual in England, and when picked are tied in round bunches and placed in water in the shelter of a building for at least twelve hours before being graded, packed and sent to market.

Grading, Bunching and Marketing. Those growers who consign direct to London, Paris and other distant markets grade their flowers with great care and make them up into round bunches of one dozen. Only the first grade is sent to London, while the third grade is generally sent to the local auction market. The colours are varied in the bunch, the ideal aimed at being 6-7 red shades, 3-4 blues and the remainder whites.

Anemones produced on the smaller general flower farms are mostly made up into round bunches of sixty blooms. These are taken to the local auction market to be purchased by the wholesale florists or forwarding agents. The latter employ special staffs to grade and re-bunch all flowers bought at auction, after which they are packed and consigned to florist customers in all parts of Europe.

Packing. The round bunches of one dozen are packed in the familiar "pad" or cane basket. These "pads" are made locally from a type of giant rush that grows in the district. The pad is first lined with newspaper and then with one of the many types of waxed or tissue papers. The methods of packing vary considerably according to the grade of flowers. The best quality blooms consigned to London are generally packed two dozen bunches in a pad, the pack being double-ended. The lower grades with shorter stems are often packed as tightly as possible and, in some instances, a cord threaded through the centre of the bottom of the pad is used to secure the stems.

Transport. A special service of insulated trucks for the transport of flowers from the Riviera to distant markets is run by a company known as the S.T.E.F. (*Société de Transports Européens Frigorifiques*) which operates over all Europe. Flowers consigned to London travel via the train ferry and

the trucks are not opened after leaving the Riviera until the destination is reached. The trucks are double-walled with cork insulation, steam-heated in winter and kept cool in summer by means of "dry ice," with the temperature automatically regulated.

General. It will be realized from the foregoing that the methods employed in southern France for the production of anemones as cut flowers differ in many respects from those followed in this country. It is obvious, however, that many of these differences are due to the effect of climate, and this fact must be taken into account when comparisons are made. The intense heat and low rainfall in summer make the use of artificial watering imperative. The water supply is thus under control in summer and to some extent over a considerable part of the flowering period. Straw mulching also assists in warding off the sun's rays and conserving moisture in the soil.

There are other points of difference that do not appear to be particularly affected by climatic factors and which merit the careful consideration of anemone growers in this country. These are:

(i) The practice of saving seed from selected plants of proved strains and the raising of corms on a soil similar to that in the flowering beds, which would appear to possess certain advantages compared with the purchase of corms of unknown parentage

(ii) The raising of the beds above the path level, which assists drainage and probably keeps the soil warmer Picking and weeding are carried out from the pathways and the soil is not trodden near the plants

(iii) The planting of corms in clumps, 12 in. by 16 in, which enables the grower to keep the surface stirred and free from weeds. The mutual protection of the plants in each clump possibly induces a longer flower stem

(iv) The application of a straw mulch, which reduces the growth of weeds and preserves the surface tilth in periods of heavy rainfall. The periodical application of nitrogenous top dressings whenever the plants show a light colour in the leaves seems to account for the continuous growth and the regularity of flowering

(v) Finally, the fact that the finest quality anemone flowers are produced either on virgin soil or on land which has been completely rested for several years indicates that the practice is a sound one.

In conclusion, it must be clearly understood that the Riviera is by no means a natural paradise where anemones flourish with little or no attention. Even where optimum soil conditions occur, the most important factor is undoubtedly the continuous skill and meticulous attention given to the plants by the cultivator.

THE USE OF A BALER FOR HAY HARVESTING

H. J. Denham, M.A., D.Sc.,

and

W. H. Cashmore, B.A., N.D.A.

Hay baling in the field was practised in England as far back as 1880, when a hay baler was demonstrated at the Royal Show at Derby, and one of the Judges spoke favourably of its possibilities. Its use, however, was very limited, possibly because of the high cost of the operation compared with the usual methods.

The rapid improvement in the modern tractor and the introduction of tractor and car sweeps have now made hay baling in the field practicable and the method is becoming increasingly popular. As a result of this development new and improved types of baler are now on the market.

In almost any kind of season a standard farm baler is capable of handling 200 tons or more of hay or straw, and unless something approaching this amount is harvested, the cost is high, on account of the initial capital outlay. A less costly machine, capable of baling from 20 to 100 tons of hay in a season, is required for the small farmer.

The Institute for Research in Agricultural Engineering has carried out experiments since 1932 with the object of determining how far baling is practicable in England with modern machinery, the best way of handling various machines, what modifications, if any, are required and the correct method of storing the bales. These experiments have for the most part been carried out in the drier parts of England, where cocking is not generally necessary.

Standard balers are of two distinct types; Ram balers and Press balers. Each of these types can be sub-divided into stationary and pick-up machines

A *Ram Baler* of the pick-up type, which has met with considerable success in America, was purchased by the Institute. It was the smallest of three sizes, and made a bale 14 inches by 18 inches in cross section. It was designed for haulage by a tractor with a power take-off driving the pick-up and baling mechanism. The pick-up consists of spiked tines delivering to a chain elevator, the whole being flexible so as

to follow the contours of the land. It delivers the material to a horizontal chain conveyor which in turn automatically feeds the baling device. The baler is similar to a standard stationary baler except that it is driven from the tractor power take-off shaft. Two men, one of whom stands on each side of the baling chamber, are necessary to work the machine. One feeds dividing boards into a carrier and so regulates the length of the bales. The same man controls the cross conveyor, which can be stopped or started in either a forward or reverse direction. This action is sometimes necessary to clear a blockage without stopping the machine. In America it has been found advisable to have a third man on this type of machine to keep the cross conveyor clear.

Iron wires are threaded through slots in the division boards and tied while the bale is under compression exactly as with a stationary baler. The compression of the bales is varied by two screw clamps at the end of the baling chamber.

A safety clutch is provided to prevent damage and warn the operator of undue strain. The weight of the machine is about 3½ tons and on level ground the total power required is supplied by a tractor of the 10/20 class.

Press Balers have overhead automatic feeding and the stroke of the press is downwards. They are completely self-tying, using binder twine or, with the larger machines, sisal twine. The needles do not have to be forced through the compressed material, but have a free passage behind the press. The size of bales can be altered by a small gear box, which operates the trip for the self-tying mechanism. Three sizes can be made, and the compression is controlled as on the ram balers by two screw clamps at the outlet. The pick-up model takes the hay from a light windrow and ties with two strings. The machine is considerably lighter than the pick-up ram balers. A collecting chute enables 10 to 12 bales to be dropped in a heap to facilitate transport of the bales.

Ram Balers: *Performance.* The average rate of working over season is about 1.3 tons per hour when used as a pick-up baler and about 1.75 tons per hour as a stationary baler.

In a crop yielding 25 cwt. per acre and where the windrow consists of two swaths of a 4 ft. 6 in. mower, a machine travelling at 2 miles per hour would lift about 132 lb. per minute. This is equivalent to about 100 bales of 80 lb. per hour or nearly 3½ tons per hour. The theoretical maximum

of the machine at this speed, calculated from the strokes of the ram required to make a bale, is approximately 3½ tons per hour. The difference between the theoretical and the actual rate is due to the fact that frequent stops are necessary to allow the men working on the machine to keep up with the wiring. Working on a moving machine naturally slows this rate down further still. Over short periods 2½ tons per hour can be baled and the rate increases as the operators become more experienced.

Labour. In addition to the labour required for windrowing, a pick-up baler requires one man on the tractor and two on the baler, with the possibility of an extra man to keep the cross elevator clear. Further, two or three men with a lorry are necessary to collect the bales from the field. They are collected at about twice the rate of baling, the time taken depending on the distance between the field and the storage place.

A stationary baler requires six men to work at full capacity, two sweeping hay to the baler with motor car or tractor sweeps, two feeding the baler, and two operating the baler. Stacking or loading on to a waiting lorry can be done by one man working full time.

In all instances the size of the bales can be varied by the operator who inserts the division boards. The best size for handling is one weighing 75 to 95 lb. at the time of baling, and from 3 ft. to 3 ft. 6 in. in length, according to the compression.

The pick-up baler requires a tractor capable of giving 11.0 drawbar horse-power, or when used as a stationary baler, about 5 to 6 h.p. on the belt.

As regards convenience or cost of working, there is very little to choose between a pick-up and a stationary baler. The advantages of pick-up baling are:—

(1) Fewer men per ton of output
(2) Hay sweeps are not required.

The advantages of stationary baling are:—

(1) There is no necessity to make windrows of exact size.
(2) The material can be baled damper without the risk of the machine blocking.
(3) The rate of working is higher.
(4) Bales can be delivered on to the stack or on to lorries instead of being scattered around the field.
(5) The power required to operate the baler is less.

Press Balers: *Performance.* The working figure for baling with a heavy type stationary press is 2 to 2.5 tons per hour. The smaller pick-up machines will deal with about 1½ tons per hour. The large sized machine makes bales 3 ft. 9 in. by 1 ft. 4 in. in cross section, which can be made in lengths of approximately 16, 21 or 26 in. Three strings are used with this machine and two with the smaller pick-up baler. The latter makes a bale about 3 ft. 3 in. by 1 ft. 3 in. in cross section.

Labour. The labour requirements for pick-up baling (excluding collection) are one man on the tractor. For stationary work 5 men are necessary, 2 on the sweeps, 3 feeding the baler. One man is sufficient on the stack or lorry. The labour required for picking up the bales tied by the pick-up baler is similar to that for Ram baling.

Special Balers. A special type of self-tying pick-up baler recently introduced in America produces bales 18 in. by 21 in. cross section of any length from 20 in. to 30 in., weighing about 25 lb. The bales are spun somewhat in the form of a hay cock with a hole through the centre. It is claimed that they dry out more quickly than normal bales, so that the hay can be baled at higher moisture content, thus saving time in the field and increasing the nutritive value.

For farms having less than the economic amount of hay required for a standard sized baler, another American machine might be useful. This has a capacity of ½ to 1 ton per hour and makes bales 14 in. by 18 in. in cross section. It is worked with horse gear.

For smaller quantities still it is possible that some of the small hand presses, making bales about 2 ft. cube, weighing 50 to 90 lb. might be used successfully.

In order to obtain the best results when baling hay in the field several details need close attention. A matter of great importance is to have the material well mixed, so that there are no wet patches at the time of baling.

It is possible to have an average moisture content of 25 per cent., composed of hay at 18 per cent., with patches at 45 per cent. or more. These patches invariably cause mould and brown patches in the hay. Good mixing is obtained by careful tedding and an extra operation in this respect, preferably immediately after cutting, is advisable. In addition to giving good mixing this has the additional advantage of hastening the field drying.

Another problem is to know when the hay is in a fit state to bale, i.e., to know what the moisture content is at any one time. For experimental work a modification of the alcohol extraction method was used, so that estimations could be made on the spot. With practice the moisture content over the range 15 to 40 per cent. can be estimated by observation and feel to within 3 or 4 per cent. The following facts are a rough guide to moisture contents:—

(1) Definitely too damp for stacking and fairly damp to the touch—30 per cent. upwards.
(2) Just safe for stacking—23 to 26 per cent.
(3) Dry hay cut from the stack—15 to 16 per cent.

When hay is baled at a moisture content higher than 18 per cent., heating takes place. The amount of heating depends on the moisture content, the amount of compression of the bale, and the state of ripeness of the crop; the younger the material the greater is the heating. Excessive heating is undesirable because it leads to loss of colour, loss in dry matter, and dustiness.

Any heating in the bales above 105°F. is likely to be harmful. It is guarded against by varying the density of the bale according to the hay moisture content at the time of baling.

The critical density of bales for various moisture contents has been found to be:—

Moisture Content at time of baling Per cent.	*Critical Density lb per cub. ft.*
30	9·0
25	12·5
20	16·0

At densities a few pounds per cubic foot higher than the above for the corresponding moisture contents, there is a loss in quality and a loss in dry matter of from 3 to 10 per cent., due to excessive heating.

The maximum temperature in the bales is usually reached in 5 or 6 days after baling, and under the worst conditions it rarely exceeds 125°F., as, unlike a stack, there are opportunities for loss of heat through the gaps. The drop in temperature to normal is quite rapid after the maximum has been reached.

Excess moisture is lost fairly quickly, and for initial moisture contents between 20 to 30 per cent. the final dry state of 15 to 16 per cent. is reached in 11 to 12 days, provided

air spaces have been allowed between the bales. When the saturated air reaches the cooler surface of the bale the moisture is condensed and sufficient ventilation is required to carry away this condensed moisture.

Storage. Bales from ram type balers should be stacked with gaps of a few inches between the rows and similar gaps between bales in the row. They should be stacked on their narrow sides to reduce the surface contact to a minimum. The top side of a bale from a ram baler has a comparatively uneven surface compared with the bottom side and if care is taken to place smooth to rough sides the ventilation is improved.

Bales from the self-tying press balers are not so compact or neat and the density is about 7 to 10 lb. It is therefore not so necessary to leave gaps, and in fact this is not possible without great trouble. Very slight ventilation is found to be more likely to cause mould than no ventilation at all, and so it is advisable to stack as closely as possible in order to make conditions similar to those inside a hay stack. The heating that takes place does not rot the twine as might be expected.

Feeding Value. Experiments have been carried out in co-operation with Imperial Chemical Industries, Ltd., at Jealotts Hill, to compare the feeding value, both chemical analysis and digestibility of hay baled at different moisture contents being compared with stacked hay from the same material. The most satisfactory figures were obtained for hay baled at moisture contents varying from 20 to 24 per cent. With increasing initial moisture content the digestibility falls, but not to any very great extent until a critical moisture content of 40 per cent. is reached, at which point a serious drop in digestible protein takes place. Hay baled at moistures below 20 per cent. is inferior in feeding value, probably because of the loss of digestible leafy parts of the crop, which are always drier than the main bulk. The crude protein figure for these samples was the lowest of the series.

Often when hay is baled at initial moisture content of 28 per cent. or more there are a few dark patches, but up to 28 per cent. the green colour is more prevalent. At 32 per cent. and over the hay is definitely dusty, because of the formation of mould before the bale becomes dry. These points depend largely on the compression of the bale.

In a comparison between stacked and baled hay, material was baled at 25 per cent. moisture. Similar material was left until dried down to 17 to 18 per cent. next day and then stacked. Baling saved the fall in digestibility of the protein. In the stack sample the total protein was low because of mechanical losses.

Conclusions. Hay baling in the field has much to recommend it, provided the amount of work to be done each season is sufficient to justify the cost of the baler. Most attention has been given to machines costing about £200, which should bale from 150 to 200 tons of hay or hay and straw in a season. These machines have an average rate of working of from 1.5 to 2 tons per hour, and 12 to 15 tons in a full day.

There is little to choose between pick-up baling and stationary baling in conjunction with car sweeps, except with self-tying balers, where there is a definite saving in labour when using a pick-up.

At present no very satisfactory method of handling bales dropped in the field has been devised, and this is the chief drawback to pick-up baling.

Where hay is to be sold off the farm, the wire-tying ram baler is most satisfactory on account of neatness and compactness.

Self-tying balers are cheaper to operate, and are quite satisfactory for hay intended for consumption on the farm.

The advantages of baling over normal harvesting methods are:—

(1) Increased feeding value.

(2) Saving in field time because baling can take place at slightly higher moisture contents.

(3) The convenience of handling the hay in the winter months, thereby saving time and labour, and avoiding a good deal of waste.

Certain care is necessary in making the hay in the field, also in baling at the right compression to suit the moisture content and in having the correct method of storage.

There is not much available information on suitable baling machinery for small acreages, but small power balers or hand balers are in existence.

LAND DRAINAGE : AN ACCOUNT OF WORKS OF IMPROVEMENT IN THE MEDWAY AREA OF THE KENT RIVERS CATCHMENT BOARD

Prior to the formation of the Kent Rivers Catchment Board there existed in Kent no less than five Catchment Boards situated either wholly or partly within the County. These were—The Medway, Stour (Kent), Romney and Denge Marsh Main Drains, North Kent Rivers and Rother and Jury's Gut Catchment Boards. By an Order of the Minister the first four of these were, on April 1, 1937, amalgamated into one Board under the title of the Kent Rivers Catchment Board. At the time of the amalgamation three of these four Boards were actively engaged in carrying out schemes of improvement approved for grant by the Minister. It is proposed in this article to give some account of the works that have been carried out with the aid of grant by the old Medway Catchment Board, whose programme of work is now being continued by the Kent Rivers Catchment Board.

The Catchment Area of the Medway is approximately 815 square miles, of which 114 square miles may be termed lowlands deriving special benefit from drainage works. The length of " main " river under the direct jurisdiction of the Board is 161 miles, and throughout this length there are numerous sluices and other structures, for the maintenance of which the Board is responsible. There is a further heavy responsibility in respect of a length of no less than 87½ miles of tidal river and sea frontages along which there are artificial defences, inclusive of the sea defences of the Isle of Sheppey.

At the time of the formation of the Medway Board three Navigation Authorities had jurisdiction for navigation purposes over various reaches of the river. Two of these Authorities are still in existence and retain their powers. The Medway Conservancy control the reach extending up the tidal estuary to a point near New Hythe, while the Medway Lower Navigation Company's reach extends from New Hythe to Maidstone. The powers and duties of the third Authority, the Upper Medway Conservancy, which extended from Maidstone to Tonbridge, have been transferred to the

Catchment Board. The existence of these navigation interests have naturally been borne in mind when considering works for the improvement of drainage. Certain lengths of the tidal river embankments and of the sea defences were under the control of Commissioners of Sewers, but for the greater part the tidal embankments were not within the area of any Drainage Authority, but were in the care of private individuals.

When the Board came into office it was soon realized that, owing to the deteriorated state of the sea defences and the inefficiency from the drainage point of view of the " main " river and sluices, considerable sums of money would have to be spent if the extensive area depending upon these works was to be preserved. It was further realized that as drainage works cannot be carried out piecemeal, each part having direct relation to its neighbour, some comprehensive scheme would be necessary. Whilst the Board carried out the specially urgent repairs on the sea defences so as to prevent inundation along the Swale and the Isle of Sheppey and elsewhere, efforts were mainly centred in developing a comprehensive scheme with the object of giving benefit to the whole area.

A general survey enabled the Board's Engineer to prepare a first partial scheme, estimated to cost £144,000, comprising the improvement of the channel of the River Medway between Allington and Farleigh Locks, the provision of automatic flood gates at Allington, Farleigh, Teston and Hampstead Locks, and also the clearance and improvement of the Rivers Beult and Teise. This first part was followed quickly by a second, estimated to cost £275,000, which extended the programme of channel improvement and sluice reconstruction, and provided for considerable works upon the sea defences, and both schemes were approved by the Ministry.

A third instalment, which completed the comprehensive proposals for the area, provided for the improvement of a length of the tidal channel of the River below Allington. The combined estimated cost of the total scheme is £450,000, and ranks for grant aid to the extent of 33⅓ per cent. of the loan charges on the first two parts (£419,000), and as to 50 per cent. of loan charges on the remainder. Actual work commenced upon the schemes in the autumn of 1934.

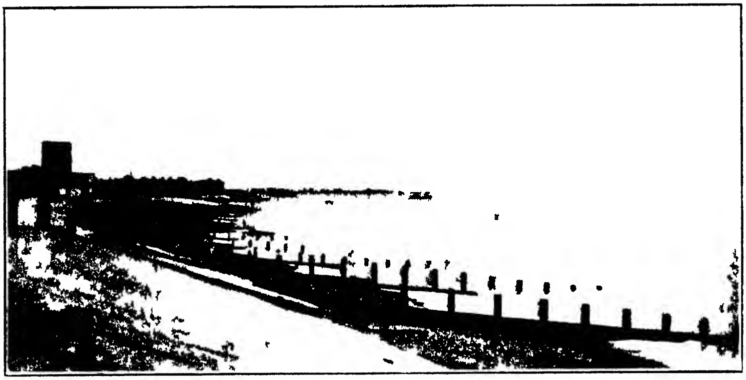
Sea Defences in the Tidal Estuary. The sea walls consist in the main of clay embankments, which in the more exposed

positions are protected on the seaward face by stone pitching or brick burrs, but in sheltered stretches and where protection is afforded by saltings the seaward face is grassed over only. These walls at the time of formulating the scheme were found to be of insufficient height to withstand high tides and both the seaward face and the wall itself had in many instances so deteriorated as to become dangerous.

Before any works were undertaken, a detailed survey was made of all the sea walls, and as a result of this survey it was decided that some 51 miles of walls should be heightened and strengthened. A level of 16.5 Ordnance Datum (Liverpool) was adopted at first as a temporary minimum height, the object being to attain a final height of 17.5 O.D. as a minimum, with increased heights in exposed positions. Up to the present date considerable progress has been made, approximately 17 miles of walls having been dealt with. The work has been carried out with the assistance of dragline excavators, the method adopted being to take clay from a ditch behind the sea wall and to use this material for the improvement of the wall, the ditch forming an internal drain. This method of construction has the advantage that it not only provides material for use on the wall, but at the same time assists the internal drainage of the marshes. Care has of course been taken to grade the internal ditches towards the numerous tidal sluices, which are over 100 in number. It should at this point be stated that a number of these tidal sluices were in a derelict state, and advantage has been taken while reconstructing the walls to construct new sluices where necessary. In some places consideration of the internal marsh drainage has enabled the construction of one new sluice to take the place of two or more old sluices. The new sluices have been constructed of concrete tubes and cast-iron pipes, the outfalls sometimes being supported on piles. Provision has been made by means of removable dam boards or penstocks on the landward side to enable the retention of water on the marshes during dry periods for cattle drinking and fencing. The new stone pitching consists of rough blocks of Kentish ragstone, approximately 1 ft. thick, laid directly on the clay and tightly wedged together. (See Fig. 1.) The stone is delivered where required in the Board's own barges.

At Sheerness, Graveney and Seasalter, where the conditions prevailing have necessitated it, and where there is evidence of littoral draft, the scheme has included for the erection or

Fig. [illegible] Sea Wall at Murton showing Stone pitching



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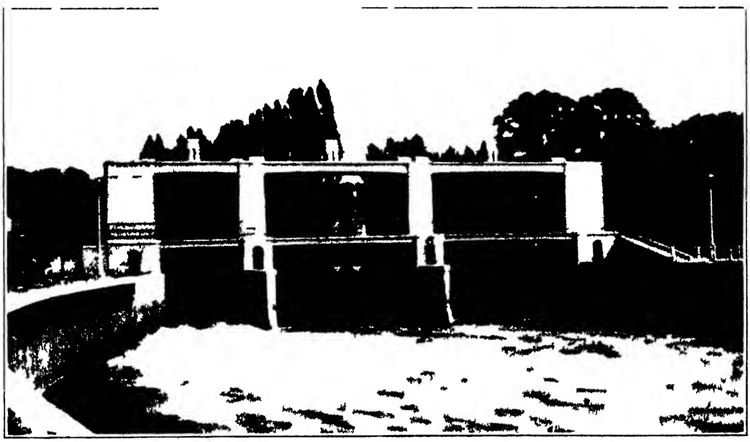


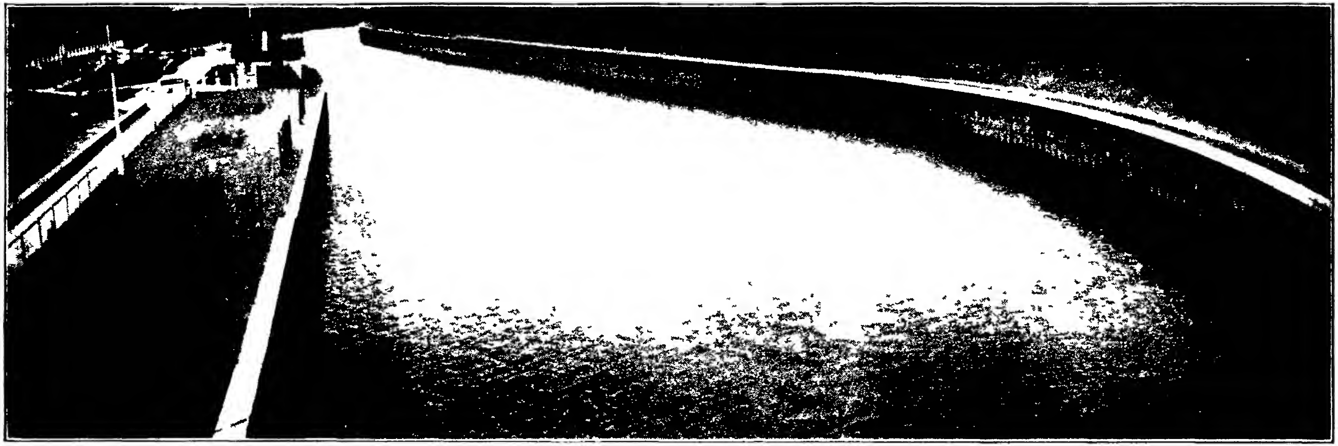
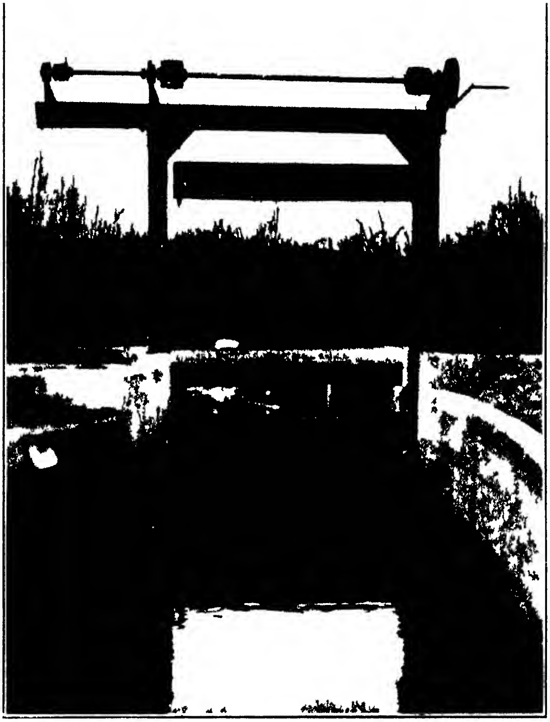


Fig. 4—The improved Channel below the Sluices



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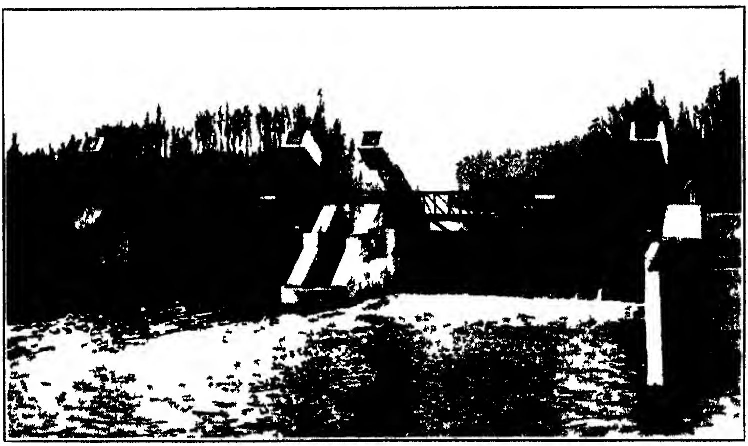

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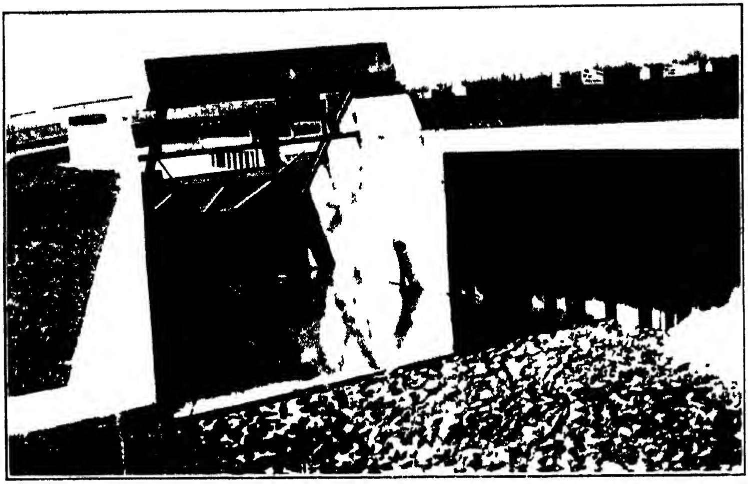

FIG 7 Automatic Sluice at Cheveney

FIG 8 Work in Progress on a New Cut R Beult

renewal of timber groynes. The Sheerness groynes were found to be in a very poor condition, and in reconstructing these opportunity was taken to lengthen and re-align them. (See Fig. 2.) Much of the old timber has been attacked by the teredo worm, rendering necessary the use of Jarrah, which has been found to be the cheapest timber that resists this worm. Additional groynes have also been constructed at Shellness and Warden Bay.

The heavy responsibilities of the Board in relation to sea defences were clearly demonstrated during the recent high tides and gales. The readings taken show that the tide reached a height of 16.23 Ordnance Datum (Liverpool) at Sheerness, which exceeded any previous recorded level by a matter of some 6 in. Damage estimated at £31,420 was done to the walls in a few days. As a result of the experience gained, it has been decided to increase further the height and stability of the walls in exposed positions.

Improvement in Tidal Channel Below Allington Sluice. The Engineer's detailed survey of the tidal reach below Allington Sluice showed that, in order to derive full benefit from the proposed works in the lower reaches of the non-tidal river and from the reconstruction of Allington tidal sluice, it would be necessary to widen and regrade the river for a length of nearly 3 miles. A detailed scheme was worked out and the improvement is now well in hand. The river is being widened from an average of 90 ft. to widths varying from 120-150 ft. To avoid any difficulties in the disposal of spoil, strips of land of 150 ft. width from the edge of the river have been acquired and spoil is being deposited on these to a depth of from 5 ft. to 7 ft. In places where this method could not be adopted, spoil is used for filling disused loops of the river. Large dragline excavators, fitted with 70 ft. long jibs that enable them to dredge the centre of the river from the banks, are being used for the dredging. The dredging in places has been exceptionally hard owing to the presence of ridges of ragstone in the river bed, but the dredgers have quite successfully dealt with these. In addition to the dredging work, the plans provide for the rebuilding of several tidal sluices and for protecting the foundation of Aylesford Bridge from scour which will be set up by the increased velocities.

Allington Tidal Sluices. These sluices mark the division between the tidal and non-tidal compartments of the River

Medway and are situated some 2 miles below Maidstone, spanning the full width of the river. There is, however, a side channel provided with a lock-pit used for navigation purposes, but not in the ordinary course of events for the discharge of flood water.

The original sluices were under the jurisdiction of the Medway Lower Navigation Company, and a Deed of Arrangement was entered into between the Navigation Company and the Catchment Board by which the Navigation Company made a substantial contribution towards the cost of the new sluices.

These original sluices consisted of two folding gates, one of which was 34 ft. wide and the other 23 ft. wide, and these were provided in their lower parts with slackers that were opened in flood time. In extreme circumstances, the gates themselves were folded back so as to give a free opening; the depth of the gates was, however, only 11 ft. 10 in. and 9 ft. respectively, and it was difficult in flood time to open the gates to their full capacity.

The new gates consist of three vertically rising roller-gates, two of which are 30 ft. wide and 15 ft. deep, and one 16 ft. wide and 15 ft. deep; the two former are electrically operated by hand switch-gear and the latter is electrically and automatically controlled so as to maintain a level in the navigation pen above the sluices in normal times of flow. The larger gates are used as flood discharge openings in times when extra capacity is required. All the gates are capable of hand operation in the event of failure of electrical energy or mechanical breakdown. (See Fig. 3.)

The sluices have been designed to discharge 5,610 cu. ft. of water per second at " high water " ordinary spring tides, which is equal to 3,030,000,000 gal. of water per day, without overflowing the banks of the channel above, when the works of improvement in the channel itself have also been carried out. It is interesting to note that the old sluices could discharge only 1,575,000,000 gal. of water per day under similar conditions.

The counterbalances for the gates consist of cast-iron weights, which are " housed " in the concrete towers to avoid an unsightly structure, and amenities have been borne in mind so that the appearance of the vicinity has been preserved.

As it was desirable to ascertain the daily flows through these sluices, recording instruments are provided for measuring the

water level, both up-stream and down-stream of the sluices, and the opening and closing of the gates is automatically recorded.

The channel immediately below the sluice has been widened and the banks protected with steel sheet piling surmounted with a reinforced concrete coping. (See Fig. 4.) The sluices were formally opened by the Minister of Agriculture and Fisheries on August 4, 1937.

River Medway—Allington, Maidstone, Farleigh, Tonbridge. The Upper Medway valley has in the past suffered from frequent inundations, which caused much damage in the borough of Maidstone and in the rich fruit and hop districts lying between Yalding and Tonbridge. Channel improvements are contemplated throughout the Allington-Tonbridge lengths, but very little work has yet been carried out. Between Allington and Farleigh difficulties will be experienced with the disposal of spoil because of the industrial development along the river banks and the steep-sided valley, and it will probably be necessary to remove all the spoil in barges. To provide temporary relief in the Yalding neighbourhood, it is intended to make an early start upon the channel improvement immediately below there and to construct a series of new cuts. It is calculated that the improvement of Allington Sluice together with the channel improvements will have the effect of reducing the water level during times of high flood by approximately 2 ft. in the borough of Maidstone, and 3½ ft. on the down-stream side of Farleigh sluices. These 3½ ft. gained will be available for the relief of flooding in the low-lying areas adjoining Yalding and Laddingford.

Any scheme for a valley such as that of the Medway must provide for the retention of water during the summer months so as to maintain a proper water table for the hops and fruit. To this end provision is made in the scheme for the construction of a number of automatic sluices across the river. Work is about to be commenced on such a sluice at Farleigh, which will be somewhat similar in type to that at Allington. The reconstruction of East Peckham sluice, a work undertaken by the Catchment Board as a matter of emergency before Government grants were generally available, is well worthy of mention. This sluice is provided with two radial gates, each with a span of 42 ft. The operation of these gates, which are automatically controlled by means of a series of

floats and counterbalances, maintains a constant minimum up-stream water level. (See Fig. 5.) In addition to the benefits to Maidstone and the fruit-growing areas, it is anticipated that, when the whole of the works have been completed, much relief from flooding will be afforded to the Tonbridge area.

Beult and Teise. These rivers, the former of which is the largest tributary of the Medway, drain an extensive area of the Kentish Weald, and both in their lower reaches pass through hop and fruit growing areas very liable to extensive flooding. Channel improvements, which it is proposed to carry out, should do much to alleviate this position. To provide some immediate relief at the lower end of the Beult, a scheme of work is being carried out that consists of widening and dredging the existing channel, and straightening it in a number of places (Fig. 6). Here again the retention of water is of great importance and, in this connexion, an automatic sluice has been constructed at Cheveney to control the flow through the new cut past the mill. The sluice, which is provided with an automatically float-operated radial gate, has proved very successful (Fig. 7). The dredging is being carried out by dragline excavators, the spoil being removed by light railway and deposited in hollows and on marshy ground.

Upper Reaches. The work in the upper reaches is mainly of a pioneer nature, consisting of clearing obstructions and tree growth. This work is carried out by hand with the aid of Trewhella Winches. Some 30 miles of river have been dealt with to date, including stretches of the Medway, Teise, Eden and Eden Brook. A considerable length of river had been dealt with by the Catchment Board in a similar manner before the grant-aided scheme was approved. As in the lower reaches the retention of water is important, and provision is made in the estimates for the construction of a number of irrigation sluices. (See Fig. 8).

The greater part of the work is being carried out by the Board by direct labour, but where the nature of the particular work justifies it, contracts have been entered into.

These notes would not be complete without reference to the establishment within the Medway Catchment Area of two Internal Drainage Boards, the Lower Medway and the Upper Medway. The programme of works being carried out by the

Catchment Board would, to some extent, be useless unless attention were given to the internal watercourses that drain into the main rivers. The Internal Drainage Boards are fully aware of this fact and have been quick to take advantage of the opportunities afforded them under the Agriculture Act, 1937, whereby grants have been made available to assist them in their work. It is to be hoped that further works will be undertaken while the grants are still available. In this way the whole of the 72,900 acres of lowlands should be satisfactorily drained in the near future.

In conclusion it should be reiterated that the foregoing description of works refers only to the Medway Area of the Kent Rivers Catchment Board. The total cost of the works, which it is proposed to carry out throughout the area of the Kent Rivers Catchment Board, amounts to £1,500,000, and it is hoped to give further details in some future article.

THE CABBAGE APHIS

(*Brevicoryne brassicae* L.)

F. R. Petherbridge, M.A.,

and

D. W. Wright, B.A.,

Horticultural Research Station, Cambridge

The Cabbage Aphis is one of the most serious pests of cabbage and related plants in Great Britain. In the dry seasons of 1921, 1929, 1933 and 1934 it reached epidemic proportions and very serious losses were sustained by growers of brassicae in many parts of the country. In the autumn of 1933 a detailed investigation of the life-history was commenced by Petherbridge and Mellor[1]* with the object of formulating methods for its control. It was found that the most economic control measures necessitated, if they were to be successful, the co-operation of all brassica growers within the market-garden area involved. Accordingly in 1936, upon request, an order was issued by the Ministry enabling the local authorities of Bedfordshire, Cambrideshire and Huntingdonshire to require treatment of brassica crops that are likely to serve as centres of infection during the spring. In 1937 this order was extended to include the adjoining market-garden district of north Hertfordshire.

Host Plants. In this country, the cabbage aphis confines its attack, so far as is known, to plants of the natural order Cruciferae. Of these, the various brassica crops, particularly Brussels sprouts, cauliflower, broccoli and cabbage are the most heavily attacked. Red Cabbage seems particularly susceptible, while some extremely heavy attacks resulting in a big reduction of the crop have been recorded on swedes. In contrast, only relatively slight infestations of kale, both of the marrow-stemmed and curly varieties, have been observed. White turnips appear to be practically immune, for even when growing adjacent to infected plants they are rarely attacked, only one instance, in which small colonies were present on a plant run to seed growing inter-

* For references, see p. 148.

twined with infected kale, being recorded. Further, white turnips artificially infected with the aphis have been found to free themselves of it during the next ten days. Rape appears to be about as heavily attacked as the kales. In the summer of 1937 white mustard plants grown for seed or as a green manure were heavily infested, colonies two feet in length being common. Infection of charlock was widespread at the same time. Small summer colonies have been noted on shepherd's purse and several other weeds.

Damage. The mealy masses of the cabbage aphis and the appearance of severely attacked plants are well known to growers of brassicae. They cause direct damage to the plant by sucking nutritive material from its tissues, heavily attacked plants being stunted, with the leaves and shoots malformed and discoloured (see Fig. 1). The central leaves of young cabbage plants are often so distorted by its attack that normal hearting fails to take place (see Fig. 2), while the presence of large colonies on the flowering shoots of brassicae seed plants so greatly distorts the stem and young pods that the seed yield is considerably reduced. The flowering shoots of mustard, and to a lesser extent of charlock, are similarly attacked and damaged.

In addition to direct damage to the plant the aphides depreciate the market value of the vegetables by " soiling " their edible parts. Their excrement or " honey dew " gives plants such as broccoli, Brussels sprouts and cauliflowers a dirty appearance and so reduces their market value. The presence of aphis in the parts of the plants that are eaten greatly reduces their value, and often causes the housewife to reject them altogether. When swedes are heavily attacked the leaves are stunted and blistered, and the crop much reduced.

Life History. During the four years 1933-37 observations have been made on the life history of the cabbage aphis in the brassica-growing districts of the Eastern Counties. Here the winter is normally spent in the egg stage on the stalks and lower leaves of Brussels sprouts, autumn and Christmas cabbage, and cauliflower (see Fig. 3). Small numbers of eggs are also sometimes laid on marrow-stemmed kale and savoys, but on spring cabbage this rarely occurs even when the plants are heavily attacked by aphis in the autumn. The aphides live well into the winter, their numbers gradually decreasing

until mid-January, when in ordinary winters all are usually dead. In the relatively mild winters of 1934-35 and 1936-37, however, small colonies of adults persisted in several localities and acted as centres of infection the following spring.

In April, 1937, an examination was made of 3,000 autumn Brussels sprouts and red cabbage plants from seed beds known to have been infected the previous autumn. No infected plants were then found. Colonies of cabbage aphis have also never been observed on charlock or other weeds in late winter, although small numbers of eggs have several times been found on charlock at this season. Such weeds, however, are normally ploughed under, but if undisturbed rarely live through the winter, so that aphides successfully hatching from such eggs would have little chance of reaching a live host. In fact, the only host plants on which the cabbage aphis has been observed to overwinter are the various brassicae referred to above.

Hatching of the eggs usually commences in late February, but severe weather conditions may delay this, as in 1934, when hatching did not begin until early April. The newly-hatched aphides usually find their way to the apices of the growing shoots, few remaining on the lower leaves. Reproduction proceeds at an increasing rate as the temperature rises in spring, and by May the colonies may be several inches long in the flowering shoots (see Fig. 4). From mid-May until early August these colonies produce winged aphides that migrate and infect new crops. This initial infection occurs earlier and is more intense the closer the situation of the new crop to the seeding plants. Thus in 1937, in the chief brassica-growing districts of the Eastern Counties where seeding plants were abundant, infection of the new crop was first observed on June 1 and became widespread and heavy by June 7. In another area, however, some 50 miles E.N.E. of the former, and where such fertile sources of winged aphis were absent, the new crop was still clear on June 12 and remained so until late in that month.

Although little is known of the distances that the winged cabbage aphis can travel, observations tend to suggest that this is considerable. Thus in 1937 a crop of autumn Brussels sprouts, 1¾ miles from the nearest source of aphis, became heavily infested in early June, while in July and August of the same year colonies were found in abundance on charlock and mustard, both growing in widely-separated districts and

Face page 14

Fig. 1 Broccoli Plant attacked by Cabbage Aphis
Oct. 5, 1937

Fig. 2 Red Cabbage Plant malformed by Cabbage Aphis
Nov. 15, 1935

[illegible]

Fig. 4 Flower Head of Seeding Cabbage with colonies of Cabbage Aphis [illegible] 4, 1937

often many miles from the nearest market-garden area. That some aphides can migrate considerable distances has been shown by Hardy and Milne,[3] who captured live winged specimens (not identified) over the North Sea at distances of 120-150 miles from the nearest land. It therefore seems extremely likely that, given favourable weather conditions, cabbage aphis also could cover considerable distances.

In the new crop each winged migrant aphis gives rise to a small colony of wingless individuals, usually in the heart of the plant. Here the young leaves are punctured, causing them to be malformed and discoloured when mature. As the colony increases in size wingless individuals wander from the centre, or are carried out by leaf growth to the outside leaves and there produce large colonies. In mid-summer these are usually located on the upper leaf surface, but in autumn the lower surface and the lateral buds (sprouts) are more favoured by the aphis. From mid-July until about mid-November winged forms appear in these colonies so that under favourable weather conditions all susceptible cruciferous plants in the neighbourhood become thoroughly infested.

Egg laying, which commences in late September, reaches its maximum in October and November and terminates about mid-December.

The natural rate of cabbage aphis increase is governed in the main by two sets of factors, climatic and biological. Of these climate is the more important. Dry warm conditions are very favourable not only to aphis increase but also to the production and migration of the winged forms. Cool, wet weather, however, very adversely affects these activities, and heavy rainstorms in particular markedly reduce in size and may entirely destroy certain of the colonies. Thus in the dry warm seasons of 1921, 1929, 1933 and 1934 this pest reached epidemic proportions in many brassica-growing districts, whereas in the wet summers of 1931 and 1936 it was scarcely in evidence.

Of the various biological agencies influencing cabbage aphis increase the chief are insect predators and parasites. They are of much importance in checking its normal increase and spread. When, however, climatic conditions become particularly favourable to the aphides, the parasites and predators appear unable to keep pace with their rapid increase, and much crop damage results. The predators are much more effective than the parasites, for parasitism or attack of

the aphides by the latter, ranges from 2 to 5 per cent. rarely reaching 10 per cent. of the individuals present. Probably the syrphid or hover fly larvae (grubs) are the most beneficial of the predators, for each larva during its development kills and sucks the contents of many dozens of aphides. The grubs or larvae of a midge *Phaenobremia* sp., recently recorded for the first time, also devours a considerable number of cabbage aphis. In certain localities in 1937 more than 50 per cent. of the aphis colonies contained the pink grubs of this midge and on some plants they appeared to be more efficacious in clearing the plants of aphis than the syrphid larvae present. Their distribution, however, appears to be irregular, for the writers were unable to find them in Suffolk. Ladybird beetles and their larvae were also often fairly common, but never sufficiently numerous to be an important factor in reducing the aphids at any stage.

Experiments on Control. Experiments on the control of this pest have been carried out at various seasons of the year. In spring the aphides are confined to the various seeding plants on which they have over-wintered and are present as small colonies in the apices of the flowering shoots. At this season colonies are rarely found on the old stem and leaves. It therefore seemed probable that the removal of all infected shoot tips would eradicate the aphis from the plant. Accordingly, in early May, both in 1934 and 1937, several small patches of seeding Brussels sprout plants were carefully examined and all infected shoot tops removed and destroyed. The colonies removed varied in size from those containing several hundred aphides to those with only a few, and in some instances only a single isolated individual. The former were easily seen, having malformed and reddened the shoot apices. The plots were subsequently visited at about ten-day intervals, when the examination and removal of the infected shoot tips were repeated. At each visit the number of colonies removed was considerable, usually exceeding that of the previous visit. Thus, on about 100 Brussels sprout seeding plants some 15 fairly large and a few small colonies were removed at the first examination, while at the fifth, made on June 18, 151 colonies were found and removed. At the last examination, made on July 12, just before harvesting, more than 1,000 colonies, mostly on the seed pods, were present on these plants. It seems probable that colonies found

after the first visit had arisen from single aphides or very small colonies that were missed at the previous examination. It was noticed, however, that this periodic removal of the large colonies almost entirely prevented the formation of winged aphides on these plants. It seems that this treatment, if conscientiously carried out, could be quite an effective method of preventing the spread of the aphis from small patches of seeding plants.

Experiments involving the use of various insecticides have also been carried out on infected seeding plants in May. These have shown that a high percentage kill of aphides can be obtained either by thoroughly spraying the plants with a 0.05 per cent. nicotine + spreader wash or by thoroughly dusting with a 3 per cent. nicotine dust. Control is rarely complete, and it is usually necessary to give a second spraying or dusting of the flowering shoots about a fortnight after the first. The Derris dusts tested proved inferior in killing power to the nicotine dusts. Neither spraying nor dusting killed the parasites within the bodies of the parasitised individuals.

Attempts were also made to control outbreaks of this pest in summer and early autumn on brassica crops growing on a field scale. In 1934 and 1936 large Brussels sprout plants, showing fairly heavy aphis attack, were treated with a 3 per cent. nicotine dust applied by power duster at rates varying from 35 to 50 lb. per acre. Some of these plants were also sprayed with nicotine at a strength of 3 oz. to 40 gal. of water, together with a spreader. These treatments were chiefly effective against exposed colonies, but none killed more than 50 per cent. of the aphides. A 3 per cent. nicotine dust applied carefully with a hand duster at a rate of 30 lb. per acre to plants of similar size gave little better control. In most instances aphides between the heart leaves remained unaffected and rapidly re-colonized the remainder of the plant so that, after a lapse of about two weeks the treated plots were not significantly less infected than the untreated. To be effective, control of this pest must be complete or nearly so on account of its enormous capacity of reproduction and spread.

In July, 1937, an experiment was carried out to test the value of treating an infected broccoli crop with a pyrethrum extract. About 5 per cent. of the plants were heavily attacked, while some 70 per cent. of the remainder were slightly so. A proprietary insecticide containing pyrethrum extract, dissolved in a light mineral oil, was applied at the

rate of 3¾ gal. per acre by hand atomizers. In certain rows all plants were treated, as it was not possible to distinguish between slightly attacked and clean plants except by careful examination. The spray possessed excellent powers of spread and penetration and was very effective against the aphides. A fortnight later, treated and untreated plants were examined and counts made of the number of plants carrying the different types of colony. These are set out in table form below:—

TABLE I

Plants with	*(a) Leaf Colonies*	*(b) Heart Colonies only*	*(c) Winged Forms only (newly infected)*	*(d) No Aphis*
Treated ..	0	24	9	18
Untreated	16	27	6	15

The treatment appeared to have entirely cleared out the leaf colonies, but colonies in the heart leaves were almost equally common on the sprayed and unsprayed plants, although usually much smaller on the former. It will be noticed that infection of the crop by winged aphis was occurring at a rapid rate.

Some three weeks later, on August 19, a second examination was made and the following counts were obtained:—

TABLE II

Plants with	*(1) Leaf Colonies*		*(2) Heart Colonies only*	*(3) Winged Aphis only*	*(4) No Aphis*
	(a) Small	*(b) Large*			
Treated ..	26	2	27	3	22
Untreated ..	28	11	24	5	18

These counts show that, at this time, the only important difference in degree or intensity of infection between treated and untreated plants was a smaller number of large leaf colonies on the former. Thus, re-infection coupled with a small residuum of live aphis between the heart leaves of many of the sprayed plants had resulted in a restoration of the aphis population on these plants to numbers comparable with those on the untreated plants.

In early October an examination showed that attacked plants were about equally common on sprayed and unsprayed plots and no differences of plant size or vigour were apparent between the two sets.

Recommended Measures of Control. From the above account of the life history it is clear that the numbers of

aphides are at their lowest in the spring and are then present mainly on brassica plants that have lived through the winter and are being grown for seed or allowed to flower through negligence. Further, since satisfactory control has only been obtained at this stage the writers suggest that the chief control measures should aim at killing the aphides on these plants before the winged forms leave them for the young crops.

(a) Brassica seed plants should be either

(1) Thoroughly sprayed during the second or third week in May with the following wash —

Nicotine (96–98%)	3 oz.
Soft soap	4 lb., or any suitable wetter.
Water	40 gallons

(2) Thoroughly dusted with a 3 per cent nicotine dust during the second or third week in May. A second spraying or dusting will be necessary if colonies are found on flower heads after the first treatment, or

(3) Examined at least every ten days from early May until harvesting and every visibly infested shoot tip removed and destroyed. This method is suited for small patches of seeding plants

(b) Although autumn-sown Brussels sprouts and red cabbage plants have not so far been found to be infected at the time of setting out, all autumn-sown brassicae should be carefully examined at this time, and if there is any suspicion of aphis they should be dipped before planting in the nicotine spray fluid suggested above.

(c) All old Brussels sprouts, broccoli, cabbage and other brassica plants should be:—

(*a*) ploughed under not later than May 15, steps also being taken to destroy any shoots that form on partly buried stalks, although this is not a frequent source of infection.

Experiments have shown that eggs of this aphis do not remain viable when buried in the soil at depths of 4 to 12 in. Also, seedling sprouts grown over buried brassicae stalks bearing eggs remained uninfected until July, the eggs by this time being all non-viable

or (*b*) pulled up and the stumps placed in heaps The heaps should either be burned before May 15, or any stumps that have formed shoots should be moved and put on the top of the heaps so that the shoots may wither.

Shoots arising from the stumps of the previous season's crop and allowed to bloom throughout the summer, as well as brassicae, on derelict holdings, are a menace to any scheme for the control of this pest. A number of instances of this have been observed in recent seasons.

(d) In fields of Brussels sprouts and other brassicae it is common to find occasional isolated plants that are heavily infested with aphis. Such plants should either be carefully

lifted, put into bags and destroyed, or thoroughly treated with an insecticide. In these circumstances the writers do not regard treatment of the whole crop to be a sound economic proposition.

A common but fundamentally bad practice is that of putting brassica seed beds near to or adjoining patches of seeding plants. Here the new crop stands the best possible chance of becoming infected and the plants are then set out, often in widely separated localities, in an infected condition.

Another method of preventing the new crop from being infected from the old (seeding) plants would necessitate legislation. *Brassica seed crops (and especially Brussels sprouts) should be grown in alternate years only.*

Brassica seed growers should be given due warning that they should grow sufficient seed in 1939 to last for two years. No Brassica seed should be grown in 1940. In the event of 1939 being a bad seed year, seed raisers should be permitted to grow a certain amount of seed in 1940 in areas remote from the main vegetable growing areas.

In the years when Brassica seeds are grown, old seeding plants should be thoroughly dusted or sprayed in the spring as suggested above.

The writers suggest that if this recommendation is carried out, it would lead to a marked reduction in the damage caused by cabbage aphis. If it were combined with the supplementary measures mentioned above, it should prevent this aphis from being the serious pest it has been in the past and make it much easier to produce cleaner Brussels sprouts and other Brassicae.

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THE MARKETING OF HOME-GROWN CABBAGE LETTUCE:

EXAMINATION OF MARKET PACKS

Cabbage lettuce is one of the most widely used salad vegetables in this country, but the home grower has to compete with heavy imports from abroad. The hold of imports on the market has been assisted by standardized grading and packing. After examination of the methods employed by exporters to this country and by the leading home growers, and after consultation with the National Farmers' Union, a National Mark Scheme was prepared and introduced by the Ministry some years ago. With the aid of the standards prescribed, facilities were given to the packers of home-grown cabbage lettuce further to improve their methods of marketing and thus place the home-grown product in a stronger position to compete with imported supplies.

The National Mark Scheme has not made such striking headway as the acreage of cabbage lettuce and the number of growers in this country might suggest, and it was therefore decided in 1937 to carry out actual examinations on the market to determine the manner in which cabbage lettuce was being graded and packed for distribution. Examinations were made on four occasions at a London market, mainly in September of that year, and the results given are published in the hope that they will be of assistance to growers by indicating certain shortcomings in marketing methods.

The sample crates of lettuces were examined in detail on the day of purchase, and on each occasion at premises near to the market stands where they were bought.

The Results. Altogether 47 sample crates were examined, with the following results:— Over 1,100 lettuces were inspected, and it was found that practically 70 per cent. of these were of National Mark standard. The number of unsatisfactory lettuces in the individual crates, however, was such that, even when a tolerance of two in each crate was allowed, only 10 of the 47 crates (slightly over 20 per cent.) could be accepted as fit to carry National Mark labels.

Over-maturity and discoloration of lettuces were frequent causes for rejection. There were heads that were decayed, or showed damage by slugs, some were not hearted, some were attacked by virus, others were devoid of wrapper leaves or were undersized. Whereas in some instances hard trimming was evident, in others trimming was insufficient, and in yet others butts were left in the form of unsightly snags.

In a few of the packs exception had to be taken to the amount of dirt present: "good lettuces spoilt by dirt" is a comment in a report on one of the crates. In certain packs, the lower layer of lettuces was filthy—the mud was not only caked to the outside leaves but the heart leaves were besmeared and unattractive. No doubt some of this mud had collected in the lower layers when the boxes were sprayed down after packing, the mud merely being hosed from the top layer to the second. There had been several days of fine weather before the last two inspections, so weather conditions can hardly be blamed for the state of the lettuces. Some of the packages of produce were commendably clean throughout.

Photographs. The photographs accompanying this article relate to packages examined in the last 2 of the 4 examinations, and will help to illustrate what has been written.

Plate 1 illustrates three boxes of lettuces taken from the collection examined on September 30. In the centre (box 2) is a carelessly packed crate with untidy finish, and on either side of it there are packs of good general appearance. On the left (box 1) there are good clean lettuces packed in a bushel box, and on the right (box 3) other lettuces of good appearance in a small lettuce crate.

Plate 2 illustrates two lettuces from box 1. On the left is a discoloured over-mature lettuce from the bottom layer, with a diameter of 3½ in., while the lettuce on the right is well-hearted and has a diameter, when reasonably compressed by hand, of 5 in. This difference in appearance indicates a substantial variation in quality. In this particular box, however, there were only 3 lettuces that did not comply with National Mark requirements.

Plate 3 shows lettuces from the other outside box of the group of three packages illustrated in Plate 1. Here we have, as already stated, another crate of reasonably clean, good-looking lettuces, but an examination of these also showed the presence of poor and discoloured specimens. The picture

illustrates a good coloured lettuce in the centre with two poor specimens on either side with discoloured edges to the leaves. In this package 3 out of 10 lettuces in the top layer did not comply with National Mark requirements, but 5 out of 8 in the bottom layer were rejected.

Plate 4 illustrates another group of three packages of lettuces, examined on October 1. The clean, attractive lettuces are in the centre crate (box 5), whilst there is a carelessly-packed crate with an untidy finish (box 4) on one side of it and a box marred by dirty lettuces (box 6) on the other.

Plate 5. The result of an examination of the lettuces in box 5 indicated that 25 per cent. of the lettuces were below National Mark requirements. Although the lettuces were clean and well trimmed, the variation in size and quality of those displayed on the crate is very marked. The lettuce shown in the centre has a diameter of 4½ in. when reasonably compressed by hand, but the lettuces on each side have a diameter of only 3 in. and 3¼ in. respectively, and are very poor looking specimens in comparison.

Plate 6 is one more illustration to show variations amongst the lettuces in a container. These 3 lettuces are taken from a crate examined on September 30. The good one in the centre, which has a diameter of 4½ in., was taken from the top layer, but the 2 poor lettuces of 3 in. and 3¼ in. respectively, on either side of it, and with practically no outside leaves, were taken from the bottom layer.

Plate 7. It is not only lettuces of poor quality and size, however, that make a package of produce unattractive. Reference has already been made to the dirty condition in which some lettuces are marketed. The 3 lettuces here illustrated are besmeared with mud front and back.

Plate 8 shows the lower layer of a crate of lettuces. Although the lettuces in the top layer (illustrated by those standing in front) look reasonably clean, the heart leaves of the lower layer in the box illustrated are dirty and unattractive.

Plate 9. The lettuces here illustrated were unattractively packed in the centre crate shown in Plate 1. They have been washed, trimmed and repacked and look the better for it.

Plate 10 is a further illustration of the unattractively packed crate shown in Plate 4 (box 4). The picture shows the second layer in the box with the 7 lettuces taken from the top layer spread around. It will be noted that there is no

neatness or order in packing this layer any more than the top layer.

Plate 11 shows the bottom layer in box 4 (Plate 4). The empty spaces at the end of the crate should be noted. The order of packing the lettuces from one end to the other was as follows, 3, 3, 1, 2, 1, making a total of 10 in the bottom layer. The other two layers contained 7 lettuces each, so that the total for the box was 24.

Plate 12 shows what box 4 looks like when the lettuces are trimmed, washed and repacked. A good deal of difference will be noted in the appearance. It may be stated that all 24 lettuces were of National Mark standard as regards size and quality. Surely a little more care could be taken in packing. Imported lettuces are normally packed well, and home-grown good quality packs of lettuces should be made equally presentable.

Comments on the Results. The market investigations indicate that:—

1. The top layer of lettuces in the package may be deceptive and not thoroughly representative of the contents.
2. The packs of good general appearance are not, on examination, always the best.
3. Carelessly packed crates may contain some of the best lettuces.
4. There is need for the wider adoption of the National Mark Scheme in the interests of both growers and buyers, but in order that packs shall comply with National Mark standards a little more attention to detail is needed:—

   (*a*) in selection of the lettuces by the cutters in the field;
   (*b*) in trimming the produce;
   (*c*) in preventing the leaves from becoming muddy and unsightly; and
   (*d*) in general presentation.

The lettuces might be made less unsightly if they could be packed in single layer boxes and taken to a packing shed for packing, or they could be dipped when dirty instead of the top layer being sprayed. It will be recalled that approximately 70 per cent. of the lettuces examined were of National Mark standard, but rejected lettuces included those that were badly soiled and carelessly trimmed; thus a still greater percentage would have been of the required National Mark standard if a little more care in selection and packing could

BOX 1 **BOX 2** **BOX 3**

PLATE I

For description of this and the following plates the text of the article should be consulted

PLATE

PLATE 3

PLATE 4

PLATE 5

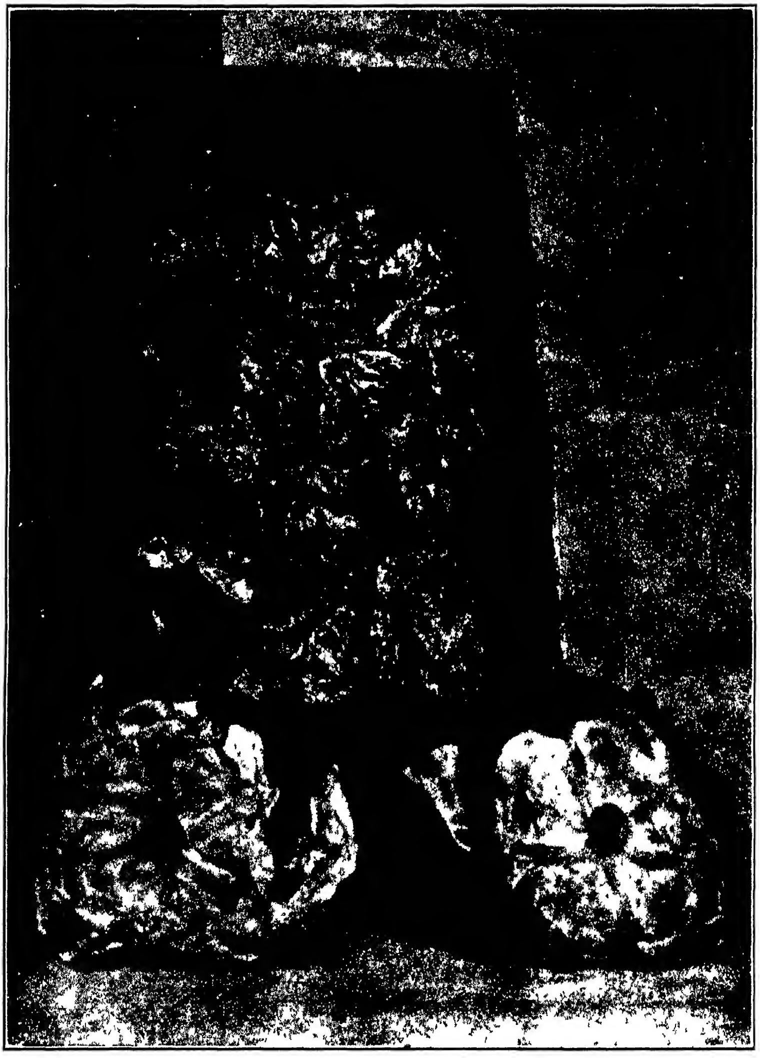
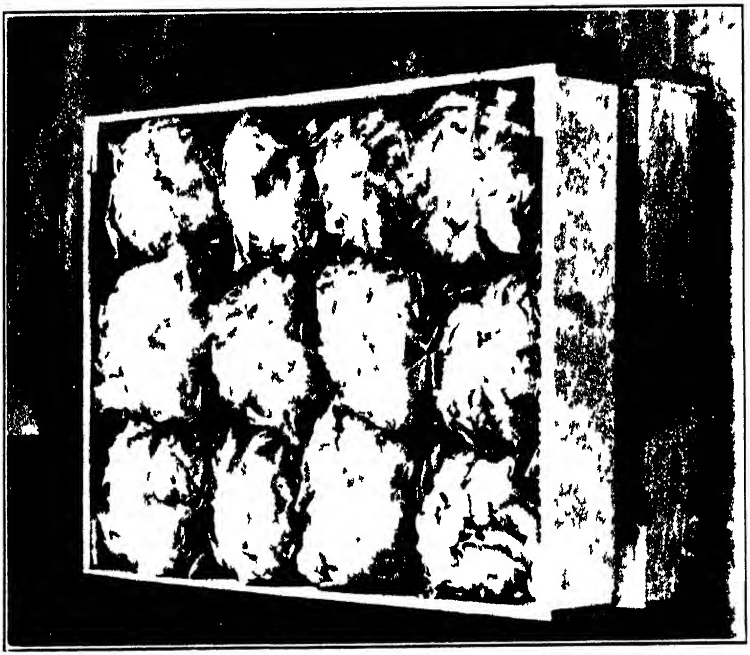


Plate 8

PLATE 9



have been exercised. It has been estimated that 16 of the 25 packages examined on the last two occasions could have been made good enough to carry the National Mark label, but only six, or less than 25 per cent. of the packs, as marketed, actually reached the National Mark standard as regards quality and, of these, two failed on packing.

Imports. Although the investigations were carried out mainly during September, when home-grown lettuces are in good supply, it is a fact of some importance that during that month in 1937, imports were heavier than they have been at that time in any of the previous years of which the Ministry has records. The following information provides details of imports for the years 1935, 1936 and 1937. Imports in September, 1937, were nearly three times as large as those in 1935.

IMPORTS OF LETTUCE, ENDIVE AND CHICORY INTO THE UNITED KINGDOM FOR THE MONTH OF SEPTEMBER, 1935, 1936 AND 1937, TOGETHER WITH THE TOTAL QUANTITIES AND DECLARED VALUE OF THIS PRODUCE IMPORTED DURING THESE YEARS

Period	September			January–December		
Year	1935	1936	1937	1935	1936	1937
Quantity ..	cwt. 1,731	cwt. 181	cwt. 4,931	cwt. 198,361	cwt. 232,406	cwt. 273,755
Declared Value	£ 3,011	£ 413	£ 4,800	£ 430,662	£ 470,632	£ 460,395

Imports of Cos Lettuce, Endive and Chicory are relatively small.

National Mark Scheme. This provides for two grades, one for glasshouse cabbage lettuce having a minimum diameter of 3 in. (when the lettuce is reasonably compressed by hand) and the other intended for the outdoor crop and called "selected hearted," the minimum diameter of the lettuce in this grade being 3½ in. The lettuces in each instance are required to be sound, reasonably clean and free from discoloration, compact (i.e., they must be hearted), free from damage by disease and insects and faulty trimming, the root system to be trimmed within ¼ in. of the basal leaves. Several containers, both returnable and non-returnable, are prescribed under the Scheme, and one of the best is the small lettuce crate (20 in. × 13 in. × 8 in.) which for glasshouse

lettuces is lined with greaseproof paper, a sheet of greaseproof paper also being placed between the layers, which may be packed, either head down or head to head.

Full particulars of the Scheme are set out on pages 11, 12 and 61 of the Ministry's Marketing Leaflet No. 58, a copy of which may be obtained from the Ministry, free of charge.

Progress in Marketing. Progress is being made in various directions in the marketing of vegetables. Competition tends to become intensified as time goes on, and a greater desire is being shown by growers to adopt National Standards of grading and packing, and to make use of the benefits of organized advertising, which is facilitated by participation in the National Mark Scheme. The marketing of broccoli is an instance of this. Noticeable improvement in the standard of grading and packing is evident in certain areas, and in London, for example, a keener demand is being experienced for National Mark heads; the results are encouraging and more packers are joining the Scheme.

The output of National Mark asparagus in 1937 was almost double the figure for 1936, whilst that of mushrooms for the year ending September 30, 1937, was over five times the amount in the preceding twelve months. It is confidently anticipated that the National Mark Scheme, if adequately utilized, can be equally helpful to packers and buyers of home-grown cabbage lettuce.

MARKETING NOTES

Milk Marketing Scheme. The wholesale price for liquid milk (other than Tuberculin Tested milk) in March, 1938, was 1*s*. 5*d*. per gal., 1*d*. less than in the previous month, but the same as in March, 1937. The wholesale price for Tuberculin Tested milk in March, 1938, was 1*s*. 7*d*. per gal., 1*d*. less than in the previous month.

Pool prices for March, 1938, are given below, with comparative figures for February, 1938, and March, 1937.

Region	*Pool Prices*		
	Mar. 1938 *d.*	*Feb.* 1938 *d.*	*Mar.* 1937 *d.*
Northern	13¾	15	13¾
North-Western	13¾	15	13¾
Eastern ..	14	15½	14
East Midland	14	15½	14
West Midland	13½	14¾	13½
North Wales	13¾	15	13½
South Wales	13¾	15	13¾
Southern ..	14¼	15½	14¼
Mid-Western	13½	14¾	13½
Far-Western	13½	15	13½
South-Eastern	14½	15¾	14½
Unweighted Average	13·84	15·16	13·82

These prices are exclusive of any premium for special services and level deliveries, and also of the quality bonuses for Accredited and Tuberculin Tested milks. The estimated gallonage on which quality premiums have been earned was 35,308,538.

The inter-regional compensation levy was fixed at 1½*d*. per gallon compared with 1¾*d*. per gal. in March, 1937. Sales on wholesale contracts were as follows:—

	Mar., 1938 (*estimated*) *Gal.*	*Mar.*, 1937 (*estimated*) *Gal.*
Liquid	52,623,817	49,166,814
Manufacturing	21,592,724	20,281,962
	74,216,541	69,448,776
Percentage liquid sales	70·90	70·80
Percentage manufacturing sales ..	29·13	29·20

The average realization price of manufacturing milk during March was 7.22*d*. per gal. compared with 5.82*d*. per gal. for March, 1937. The quantity of milk manufactured into cheese

on farms was 883,762 gal. compared with 605,320 gal. in the previous month and 547,080 gal. in March, 1937.

Manufacturing Milk Prices. The Milk Marketing Board and the Central Milk Distributive Committee have agreed that the price of milk delivered in April, July, August and September, 1938, for manufacture into cheese (other than Cheddar, Caerphilly, soft curd cheese, cream cheese, Stilton cheese and blue vein cheese) shall be increased by 1*d*. per gal. over the prices they originally negotiated.

Bacon Industry Bill. The Bacon Industry Bill designed to give effect to the Government's proposals in regard to the future organization of the pig and bacon industry, was introduced in the House of Commons on April 1. After a second reading on April 11, the Bill was referred to Standing Committee.

Pigs Marketing Board. *Election of Special Members.* At the General Meeting of registered pig producers held on March 31, Capt. G. Deakin and Mr. C. M. Hallett were re-elected as special members of the Board.

Milk Acts, 1934 to 1937: *Milk-in-Schools Scheme.* The following are comparative figures of the consumption of milk under the scheme in England and Wales in the quarters October to December in the first four years of the scheme.

Year	*Consumption in 3 months October–December* *Gal.*
1934	6,193,607
1935	5,788,149
1936	6,224,088
1937	6,769,607

Nutrition Survey. An interim report on the investigation into the effect on school-children of the consumption of milk in schools is summarized in a note on page 111 of this issue of the JOURNAL.

Wheat Act, 1932: *Sales of Home-Grown Wheat—Cereal Year* 1937-38. Certificates lodged with the Wheat Commission by registered growers during the period August 1, 1937, to April 8, 1938, cover sales of 18,853,696 cwt. of millable wheat as compared with 17,723,865 cwt. in the corresponding period (to April 9) of last year.

New Quota Payments Order. After consultation with the Wheat Commission, the Minister of Agriculture and Fisheries has made the Wheat (Quota Payments) No. 3 Order, 1938 (S.R. & O., 1938, No. 271), which alters as from April 10 the rate of quota payment, which millers and importers of flour are liable to make to the Wheat Commission on their output of flour, from 7.2*d.* to 9.6*d.* per cwt., that is, from 1*s.* 6*d.* to 2*s.* per sack of 280 lb.

Sugar Industry (Reorganization) Act, 1936: *Sugar Industry (Payment of Assistance) Rules,* 1938. The Minister of Agriculture and Fisheries, with the consent of the Treasury, has made the above additional rules (S.R. & O., 1938, No. 261), governing the payment of assistance in respect of sugar manufactured in Great Britain from home-grown beet.

Research and Education Scheme. The Minister and the Secretary of State for Scotland, on April 14, approved, with certain modifications, the Scheme submitted by the Sugar Commission under Section 18 of the Act making provision for the encouragement, promotion and conduct of research and education in matters affecting the growing of sugar-beet and the manufacture, refining, marketing and consumption of sugar. The scheme, with the Order approving it, will be published by the Stationery Office as S.R. & O., 1938, No. 322, price 2*d.*

Livestock Industry Act, 1937: *Cattle Fund.* The table below gives particulars of the operation of the Cattle Fund under the Cattle Industry (Emergency Provisions) Acts, 1934 to 1936, and the Livestock Industry Act, 1937:—

	Payments	*Animals Covered by Payments*	*Average payment per Animal*		
	£		£	*s.*	*d.*
April, 1935, to March, 1936	3,884,049	1,636,722	2	7	5½
,, 1936 ,, ,, 1937	3,982,146	1,690,547	2	7	1½
,, 1937 ,, ,, 1938*	3,943,770	1,578,973	2	9	11
From beginning of subsidy payments in July, 1934, to March 1938	13,823,272	5,746,578	2	8	

* The payments during this period comprised £1,357,756 for 581,655 animals certified under the Emergency Provisions Acts, and £1,515,984 for 466,996 animals of quality standard and £1,070,020 for 530,322 animals of ordinary standard certified under the Livestock Industry Act.

Subsidy Payments under Livestock Industry Act, 1937. Under the revised scheme which came into operation on August 1, 1937, subsidy is payable at the following rates:—

(1) 7*s*. 6*d*. per cwt. for a home-bred animal of quality standard;
(2) 5*s*. per cwt. for a home-bred animal of ordinary standard or for an imported animal of quality standard;
(3) 2*s*. 6*d*. per cwt. for an imported animal of ordinary standard.

The numbers and percentages of beasts certified under each category from the inception of the revised scheme to the end of February last are shown in the table below.

	Total No. of Cattle Certified	Home Bred		Imported	
		Ordinary Standard	Quality Standard	Ordinary Standard	Quality Standard
August, 1937–February, 1938					
ENGLAND ..	589,113	267,673	158,480	81,796	81,164
,, (per cent)	*100*	*45·4*	*26·9*	*13·9*	*13·8*
WALES	50,566	39,063	9,151	1,659	693
,, (per cent.)	*100*	*77·2*	*18·1*	*3·3*	*1·4*
SCOTLAND ..	181,898	28,027	92,643	8,582	52,626
,, (per cent.)	*100*	*15·4*	*51·0*	*4·7*	*28·9*
N. IRELAND ..	58,157	47,451	4,305	5,631	770
,, (per cent.)	*100*	*81·6*	*7·4*	*9·7*	*1·3*
UNITED KINGDOM	879,714	382,214	264,579	97,668	135,253
,, (per cent.)	*100*	*44*	*30*	*11*	*15*
February, 1938					
ENGLAND ..	73,941	28,235	26,925	7,179	11,602
,, (per cent.)	*100*	*38·2*	*36·4*	*9·7*	*15·7*
WALES	5,824	4,075	1,596	64	89
,, (per cent.)	*100*	*70·0*	*27·4*	*1·1*	*1·5*
SCOTLAND ..	27,760	2,694	14,957	794	9,315
,, (per cent.)	*100*	*9·7*	*53·9*	*2·9*	*33·5*
N. IRELAND ..	9,162	7,316	1,186	487	173
,, (per cent.)	*100*	*79·9*	*12·9*	*5·3*	*1·9*
UNITED KINGDOM	116,687	42,320	44,664	8,524	21,179
,, (per cent.)	*100*	*36·3*	*38·3*	*7·3*	*18·1*

Hops Marketing Scheme. Non-quota hops represented a very small proportion of the hops of the 1937 crop delivered to the Board and, after payment for quota hops had been made in full, the Board were able to pay an amount in respect of non-quota hops equal to two-thirds of the valuation of the non-quota pool.

National Mark Schemes for Cheese. In the light of experience gained in the operation of the more recently introduced National Mark Schemes for Cheese, the following amendments were made to these schemes during the year 1937:—

LANCASHIRE CHEESE The minimum age of cheese at the time of grading was reduced from 10 days during the months of June, July and August and 14 days during other months, to 10 days throughout the year.

WENSLEYDALE CHEESE. Provision was made for the inclusion of small Wensleydale cheese of not more than 2 lb. and not less than 1 lb. in weight within the scope of the National Mark scheme, the grading of such cheese to be the responsibility of the authorized packer and not of the official Grader as for the larger cheese.

LEICESTER CHEESE. Provision was made for the grading of Leicester cheese of between 16 lb. and 20 lb. in weight.

CREAM CHEESE. The requirement that the National Mark shall be applied only to cheese of certain specified weights was withdrawn, and the requirement that each cheese should be separately wrapped in metal foil of approved quality or a muslin bandage was modified to permit the use, for this purpose, of any material that may be approved by the Minister on the advice of the National Mark Cheese Trade Committee.

Particulars of the total output of cheese packed under the National Mark in each of the schemes during the year ended December 31, 1937, with comparative figures for 1936, are as follows:—

Type of Cheese	*Year ended December* 31, 1936 (*cwt.*)	*Year ended December* 31, 1937 (*cwt.*)
Cheshire—		
(*a*) Farm made ..	52,252	58,116
(*b*) Creamery made	38,681	17,446
Stilton—		
(*a*) Blue	1,378	1,116
(*b*) White	2,824	1,879
Caerphilly..	20,078	20,742
Cheddar ..	4,524	3,529
Lancashire	12,740+	14,645
Wensleydale	592+	577
Cream ..	32	52
Leicester ..	217+	850
Derby ..	—	620*

+ Scheme in operation for part of the year only.
* Scheme introduced in February, 1937.

There has been a decline in the output of National Mark cheese from creameries during the year 1937, due to a shortage of supplies of milk for manufacturing purposes.

National Mark Creamery Butter Scheme. During 1937 this scheme was adversely affected by the shortage of milk supplies available for manufacturing purposes. The quantity of creamery butter packed under the National Mark, which rose from 14,348 cwt. in 1935 (the first year of the scheme) to 30,226 cwt. in 1936, fell in 1937 to 16,261 cwt.

Fat Stock Carcass Sale by Grade and Dead Weight. During the three months ended March 31, 1938, 3,273 cattle, 8,682 sheep and 3,526 pigs were dealt with under the Grade and Dead-weight Scheme.

In conjunction with the Department of Agriculture for Scotland, arrangements were made in January last for the consignment, during an experimental period, of sheep carcasses from Ross-shire to Smithfield for sale on the basis of grade and weight.

Under these arrangements firm quotations are obtained for the carcasses from wholesalers at Smithfield. If the quotations are accepted by the producers, the sheep are slaughtered locally and the carcasses weighed and graded before dispatch to London. If on arrival at Smithfield instances of disputed grading arise, the examination of the carcasses and any necessary adjustment of the grade is carried out by the Ministry's grading staff at that centre.

During the two months ended March 31, 41 consignments comprising 1,982 carcasses were dealt with under this experimental scheme. Prior to the introduction of the scheme such carcasses were invariably dealt with at Smithfield on a commission basis.

National Mark Beef. During the three months ended March 31, 1938, a total of 87,328 sides of beef (59,762 home-killed and 27,536 Scotch-killed) were graded and marked under the National Mark. Of the home-killed sides dealt with 39.5 per cent. were graded "Select," 57.8 per cent. "Prime" and 2.7 per cent. "Good." Scottish National Mark sides graded 92.8 per cent. "Select" and 7.2 per cent. "Prime."

National Mark Publicity. During the forthcoming

summer season, National Mark exhibits will be staged by the Ministry at each of the following Agricultural Shows:—

BATH AND WEST—May 25–28—Plymouth.
ROYAL COUNTIES—June 1–4—Bournemouth.
THREE COUNTIES—June 7–9—Gloucester.
LEICESTER—June 10–11—Leicester.
ROYAL NORFOLK—June 15–16—Hunstanton.
PETERBOROUGH—June 28–30—Peterborough.
ALDERSHOT—June 30–July 2—Aldershot.
ROYAL AGRICULTURAL SOCIETY OF ENGLAND—July 5–9—Cardiff.
KENT—July 13–15—Folkestone.
GREAT YORKSHIRE—July 13–15—Doncaster.
ROYAL LANCASHIRE—July 28–August 1—Liverpool.
SANDY—August 25—Sandy.
SOUTHPORT FLOWER SHOW—August 24–26—Southport.

The Ministry's exhibits this year will be designed to appeal particularly to the producer. Working demonstrations of the testing and grading of eggs or fruit will be staged, and, at the Leicester, R.A.S.E., Great Yorkshire and Royal Lancashire Shows, live cattle, sheep and pigs will be exhibited to illustrate the various types of animal expected to yield carcasses of the grades defined under the Ministry's Scheme for the sale of live stock by Dead Weight and Grade.

A National Mark exhibit will also be staged at the Empire Exhibition, Glasgow (May-October), when a comprehensive range of National Mark products will be displayed.

A selection of the Department's publications will be on sale at each of the above exhibitions.

AGRICULTURAL MACHINERY TOPICS

S. J. WRIGHT, M.A.,
Director, Institute for Research in Agricultural Engineering, Oxford

The Paris Agricultural Machinery Exhibition

Although the *Salon de la Machine Agricole,* which is held annually in Paris during the winter or early spring, is considerably smaller nowadays than it was a few years ago, it is still of considerable importance as an exhibition devoted exclusively to agricultural machinery. A fairly accurate mental picture of the exhibition can be got by imagining our own Smithfield Show with the live stock left out and the machinery exhibits extended so as to cover all the space that the whole Show now occupies. A similar mental picture might also be applied to the persons who attend the Paris Exhibition; for it is primarily a " trade " show and local dealers and agents (who come from all over the Continent) greatly outnumber the farmers among its visitors. In the same way, if it were not for the many farmers who make a point of visiting the machinery stands when they are at Smithfield, but who probably would not be there at all but for their interest in fat stock, that Show, too, would be primarily a trade affair. Nevertheless, there are many British farmers nowadays who would visit shows even if they were confined to machinery exhibits; and quite a number of them find it worth while to pay occasional visits to the Paris Exhibition in search of new ideas.

Incidentally, a first visit to the Exhibition is liable to be misleading unless one realizes beforehand exactly what ground it covers. For example, the fact that the tractor exhibits include large models and appliances altogether outside the range ordinarily exhibited at any of our own shows, does not mean that large-scale tractor farming is more extensively practised in France than in Britain. It merely indicates that, for the larger firms, including several American manufacturers, the Exhibition is the main trade show for the whole Continent, so that it covers, in addition to ordinary farming, large areas devoted to organized forestry, as well as the various odd corners of Europe where large-scale land reclamation schemes are in progress. Nor does the exhibition of a very large number of unfamiliar implements, and particularly of unfamiliar cultivating implements, necessarily mean that French manufacturers are specially ingenious in developing new machinery. It means rather that due to the wider range

of climatic conditions, French agriculture includes many crops, and types of farming, of which we have no experience. Vineyard cultivation alone, for example, involves a whole series of implements, common enough in vineyard districts, which are nevertheless quite new to a British farmer on his first trip abroad.

Some of the general tendencies noted, may, however, be of interest. First, that of the whole range of tractor exhibits, from the vast machines intended mainly for forestry or land reclamation to the small machines of only 6 or 7 drawbar horse-power, quite three-quarters were provided with Diesel engines. At the moment this is due mainly to the fact that Continental farmers are not nearly as well served with vaporizing oils as we are, so that tractor paraffin is both expensive and of relatively poor quality. Nevertheless, the general development of Diesel engines elsewhere is likely eventually to affect our tractors as well.

Another point was the general use on all farm transport vehicles of pneumatic tyres. The exhibits at any French Show always include an extraordinary variety of carts and wagons—many of them looking as if they have hardly changed in general design for centuries. Most of these traditional types were represented in Paris this year; but every one of them was mounted on pneumatic tyres, although there was nothing remotely resembling the light low-loading tractor trailer that hundreds of our farmers now use.

Yet another interesting feature concerned artificial manure distributors. Since the writer's last visit, Continental farmers have evidently become tractor-minded enough to demand wider machines, and several models with sowing widths of 15 ft. and over were on view. The interesting point, however, was that in every one of the dozen or so models examined —and they included both large-scale and market-garden types, as well as a new machine designed to mix and distribute two different fertilizers—the distributing mechanism was of identically the same type. There was a plain hopper, the bottom of which consisted of the upper portion of an endless conveyor made of closely fitting wooden slats. This conveyor was geared to the wheels and rotated so as to bring the fertilizer out at the required rate through a slide-controlled aperture at the back of the hopper. The fertilizer was then flicked off by a series of fingers mounted on a rotating shaft. No details of performance were available, but there was no

reason to doubt that a sufficiently accurate distribution could be obtained. The attractive feature of the design was, of course, that the hopper was free from any kind of obstruction while, except for the fingers outside the hopper, no metal part came into contact with the manure. The writer can recall only one British-made machine using a distribution mechanism of this type. Although similar in principle, it was a good deal more elaborate in design and, possibly because of its higher first cost, did not meet with general approval.

An Unusual Haymaking Implement. Among the Paris new implement entries the only one of any interest was a hay-making device called a "*Javelotteur.*" As the technical dictionaries do not refer to this word it must be presumed to be coined especially for the machine, and the only translation that can be suggested is "bundler." Roughly, the implement consisted of a self-acting, rigid-tined rake behind which trailed a kind of rectangular mat 5 or 6 ft. long and made of canvas with wooden slats attached to it crosswise on the underside. On the outside the slats were supported on small wheels so that when the machine was running on a level surface the mat would trail behind supported at about 4 in. above ground level. The machine is intended mainly for use with lucerne and similar forage crops. It is run along the windrow so that the rake collects the crop in the ordinary way; and when the rake mechanism trips, the mat proceeds to roll the hay so collected into a sort of tubular bundle. A calculation based on the width of the outfit and the interval between successive lifts of the rake suggested that in a fair crop each bundle would contain some 20 lb. of hay. The claims made for the device were that it put the stuff into a form that was both reasonably weatherproof in wet weather and well adapted to rapid drying without bleaching in fine weather. It was also claimed that these bundles could, if necessary, be tied by hand for easy collection and subsequent disposal. Leaving out the last point—which would seem to demand too much labour for our farming—a device on these lines might have possibilities here. In any event the slogan advertising it is worth quoting for its own sake:—"*Le Javelotteur est aux fourrages ce que le grace est aux femmes —indispensable!*"

A conversation with the exhibitor of this machine—conducted with some linguistic difficulties on both sides—

disclosed the rather interesting fact that he was a small local implement maker who had developed it for use in connexion with another device which, although general in his particular district, was apparently unknown to the rest of France. This latter device was in effect a mower-tedder. Due to the linguistic difficulties already mentioned, his description of it was rather vague, but it seemed to be a mower whose cutter bar had some form of Archimedean screw attachment that fluffed up the swath as soon as it was cut.

Incidentally, these small local implement makers, whose stands are to be found here and there among those of the larger firms, provide some of the most interesting exhibits—at any rate from the point of view of the casual visitor—if only because they frequently include unconventional methods of construction that are nevertheless simple and effective. An example in support is provided by a device that was first seen on an earlier visit but whose ingenuity caught the eye again this year—a potato or fruit grader consisting simply of a pair of parallel wooden rollers on each of which a rope had been nailed in a spiral of gradually increasing pitch. It worked exceedingly well and could probably be made at home for a few shillings.

Food-mixing Machines. From the number of inquiries on the subject that have been received recently, it would appear that farmers are taking a renewed interest in home-mixed feeding stuffs as opposed to complete balanced rations purchased as such. On the relative merits of the two the writer is not qualified to give an opinion. It is worth remarking, however, that where larger quantities of feeding stuffs are concerned the general convenience of ready-mixed rations must weigh heavily in their favour unless proper mixing machinery is provided, capable of doing the work efficiently without great expenditure of labour. Leaving aside the large continuously-operating plants that are used in mills and factories, mixing machines for farm use are generally of one or other of two kinds. In the vertical type, the hopper, which is cylindrical in shape with a conical end leading to an outlet of smaller diameter, does not itself rotate. Mixing is done by a vertical worm that rotates at about 25 r.p.m. and is geared to a fast and loose pulley. This is a batch-type machine and the mechanism is stopped while filling and emptying. The capacities of these mixers vary from 5 cwt. to 2 tons of meal per batch. The prices run

from £35 to £70, and the power requirements from 1½ to 5 h.p. according to size. In the machines of the horizontal type, the drum or hopper itself rotates, and mixing is done by a series of baffles placed inside. This type of plant is more or less continuous in operation, for both filling and emptying are done through a reversible chute at one end of the machine, and there is no need to stop the machine meanwhile. This results in some saving of time, since mixing starts from the moment filling begins and continues until the last bit of the charge is withdrawn. Horizontal machines are not generally made in sizes below about 15 cwt., and for the same capacity the power requirement is nearly double that of the simpler machine. Their first cost is also rather higher. An interesting attachment that can be provided if required is an automatically controlled oil sprayer with which small quantities of cod-liver oil or any similar preparation can be injected in the form of a fine spray and thoroughly incorporated into the ration.

Most kinds of mixing machine can, of course, also be used for fertilizers provided that proper precautions are taken for thorough cleaning out after use. The latter is very important, both in order to prevent corrosion, and, with machines used for both purposes, to avoid contamination of feeding stuffs. In practice, cleaning out would not need to be done very often since manures would ordinarily be mixed only in large bulk lots at appropriate times of the year. Incidentally, cleaning might be done satisfactorily by putting through a moderate charge of sand or similar material—giving a rather longer run than usual—and following with a charge of ground lime.

In America, poultry farmers are being encouraged to make their own mixers for small charges of meal. One type, for which drawings are available, consists of a horizontal wooden drum of octagonal section provided with four longitudinal baffles. One of the octagonal sides is hinged to open outwards for filling and emptying, while one of the two baffles adjacent to this side is also hinged so that it can be folded flat to allow the whole charge to be withdrawn. For a charge of about 5 cwt. the drum should be about 6 ft. long and of some 30 in. diameter. It is mounted on a shaft of about 1 in. diameter, carried in simple bearings, and arranged with a suitable chain or pulley drive so as to rotate at about 30 r.p.m. The cost of construction on the farm, possibly with the help of the local blacksmith, should not exceed £2 10*s*. 0*d*.

MAY ON THE FARM

R. W. WHELDON, D.Sc.,
King's College, Newcastle-upon-Tyne

The present month is one of many changes in the north of England. "May day," means a change, in many instances, not only for farm workers but also for farmers, as the majority of farm tenancies begin on this day. Local newspapers announce large numbers of farm displenishing sales, and during April and early May auctioneers have a busy time. There is always something sad about a displenishing sale. Even if not due to death, retirement or adverse circumstances, the dispersal of stock and equipment gathered together with long thought and care, and to which the farmer is intimately and personally linked, is always rather depressing. On the other hand, there is something interesting and attractive for the new tenant who is gathering together material for a new venture.

Visits to farm sales reveal a great variation in the condition of implements on different farms. It is often said that implements on some farms rust out rather than wear out, and no doubt farm instrument manufacturers get more business than that which accrues from normal wear and tear. While it is true that there is considerable room for greater attention in the care of farm implements, there is now undoubtedly a general tendency to look after them with more care than formerly.

The introduction of tractors and other machinery that demands a measure of attention has undoubtedly awakened interest in mechanical appliances.

It is a great asset to any farm to have a well equipped implement shed where every unit is ready to perform its job efficiently. Breakdowns are especially annoying during hay-making and harvesting, and the present time is not too early to make sure that implements required for these operations are in order—if this was not done at the end of last season.

Grass Land. The rich green of spring grass and the

absence of discoloured flowering heads and tall weeds make both pasture and meadow a pleasant sight, but close examination frequently reveals the presence of numerous plants that may, in a very short time, mar this.

On pastures, the common thistle has begun growth. This plant is not only unsightly, but detracts from the grazing value. The plant is a perennial, and during the spring and summer stores up food that gives it a fresh start the following year. Early cutting, when the plant is 5-6 in. high, and, where possible, a second cutting three weeks to a month later, will do much to reduce this troublesome weed. Early cutting practised for a few years should bring it under control, likewise haying instead of pasturing.

The harmful effect of Yellow Rattle or henpennies (*Rhinanthus crista galli*) has already been referred to in these Notes. The seedlings of this weed may now be seen on infested fields. As this plant is an annual, early mowing before the seeds have been formed is a means of eradication. As the plant matures before the hay crop is fully grown, early mowing entails a sacrifice of part of the hay harvest, but this is usually compensated for in the following year. Yellow Rattle is semi-parasitic on the roots of the grasses and greatly reduces their productivity. Another means of eradication is to pasture the land, taking care to stock heavily at the time the seedlings are coming through the ground. Liberal dressings of farmyard manure in spring are also helpful. These protect the young grass, give it a good start and enable it to get away and overshadow the young seedling weeds.

The high value of good hay as a food has frequently been emphasized, while all practical feeders know that stock give poor returns from inferior hay. If grass is allowed to become too mature before being cut, the feeding value is reduced, as the indigestible fibre is increased and palatability is lost. It is fully recognized that very immature grass is difficult to win, nevertheless, cutting should not be too long delayed. The practice, which is still adopted on some farms, of leaving the crop until most of the plants have seeded results in inferior hay, poor aftermaths and plants reduced in vitality for the following season.

Manuring, and the management of aftermath, also play a most important part in determining quality. The Palace Leas hay plots at Cockle Park show that manuring and grazing

of aftermaths may increase the feeding value of the hay by as much as nearly 50 per cent., besides increasing the yield.

Cereals. For the most part winter wheat looks very well, and except on the drier soils, it has not suffered seriously from the drought. Night frosts in some districts have discoloured the plants a little, but on the whole the prospects are good. Spring-sown corn on the other hand is variable. Much of it was sown under very dry conditions and has had no rain since. The importance of good tilth is well demonstrated in a year like the present. Where cultivation has been poor the plants are thin. Germination has taken place but many of the plants have died from lack of moisture. The better the tilth, the better the plant establishment, is particularly true in a year like this one.

Spring-sown cereals are making slow growth and in the present circumstances the effect of any grub attack is likely to be accentuated. A careful watch should be kept for damage by wireworm and leatherjackets, as these do most damage in seasons when plant growth is not vigorous. The attack on roots and stem bases still further restricts growth or kills the plants completely, but this effect occurs more usually in patches and is in this respect distinguishable from the uniform failure arising from soil conditions. If signs of trouble are found, advice from the expert stationed at the Provincial advisory centre should be sought.

Pigs. The result of the recent agreement with regard to pig prices means that prices are in some measure stabilized for the next three years. While three years may be regarded by many as barely long enough it is possible to proceed with some measure of security for such a period. The margin of profit in most branches of farming is such that it is only the efficient producer who gets any profit, and pig production is not likely to be any exception. It is therefore desirable for each pig producer to take stock and determine if his present system is on right lines.

As far as feeding is concerned, much valuable information regarding rations, methods of feeding, etc., has been made available during recent years, and feeders generally have not been slow to apply this knowledge to their practice. The best results from any feeding system can only be obtained when it is applied to animals capable of making the most efficient

use of food. Good, sound breeding stock is therefore essential, whether the feeder breeds his own pigs or purchases stores. While type is undoubtedly an essential quality in bacon pigs, there are other factors that play a most important part. In the brood sow, prolificacy, milking capacity, docility and mothering qualities are as important as the ability to convert food into meat economically.

When purchasing stock or breeding animals, we are frequently governed largely by type and, perhaps, while recognizing the importance of other characteristics, do not pay them the attention that they deserve. It is true that information as to the qualities mentioned is not easy to obtain or judge, but pig recording has done something to help.

Cattle. While the winter season has closed with a low price record for sheep, cattle have maintained a higher winter price and finished strong; store cattle have commanded better prices than for many years. Although beef prices are relatively good, grass feeders are a little apprehensive as to the future, since summer and autumn prices will need to be good if any margin for summer keep is to be obtained.

Cattle have gone to grass earlier than usual, and in some instances there is now a grass shortage. Cattle, after a full bite of grass, do not go back to hay readily. If forced to do so, they usually suffer a check, which should be avoided if possible. Cattle will take cotton cake readily enough and would probably continue to make gains if this is fed. On the other hand, it is not easy to stop cake feeding once it has started, as cattle become accustomed to it. It may be worth feeding cake to the most forward animals that are likely to catch the early summer market, allowing those not so far forward to go without. A few pounds of cotton cake per day save a good deal of grass.

While some graziers have stocked their pastures, others have not purchased yet—no doubt deterred by high prices and uncertainty of return. Understocked pastures can take much harm, and efforts should be made to minimize this. Topping to prevent the seeding of grasses should be practised where necessary. If any pasture is to suffer it is better to be the poor pastures as they will take less harm from bad treatment than the really first-class feeding pastures.

Potatoes and Root Crops. It has been a record season for potato planting. Frost is feared by early growers in most

areas; in some districts farmers are doing their best to keep late varieties covered.

There is plenty of opportunity for drill cultivation in a season like the present, and if carried out much laborious hand weeding may be avoided. Weeds can be destroyed before the crop comes through, but the value of drill cultivation is by no means confined to destroying weeds, as it is also an aid to the vigorous development of the crop. Potatoes like air at the roots as well as moisture, and cultivation assists them to obtain both.

On many soils, suitable tilth for small seeds, such as sugar-beet, mangold, kale, etc., has been difficult to obtain, and the seedling plants are making slow growth. Anything that will help the plant in the early stages is an advantage. Quick-acting nitrogenous manures, such as nitrate of lime or nitrate of soda or nitrochalk, may give the plant a sufficient start and enable it to become established. At Cockle Park a liberal seeding is adopted together with the use of a light dressing of nitrochalk, ½ cwt. per acre applied by the turnip drill with coulters just clear of the ground. Such a dressing stimulates the plant and affords a measure of insurance against the attacks of the Turnip Flea Beetle. Where such dressing is not used, and the Flea Beetle requires control, the seedlings should be dusted with Derris.

NOTES ON MANURING

F. HANLEY, M.A.,

School of Agriculture, Cambridge

Placement of Fertilizers. There is still far too little reliable experimental evidence to warrant any general assertions as to the best position for the fertilizer. The problem has received much attention abroad, especially in America where very precise recommendations are made as to the exact position the fertilizer should occupy in relation to the seed. In this country, interest usually centres round two major aspects of the problem, namely, (i) is it better to bury the fertilizer deeply by ploughing it in, or to leave it in the surface layer by simply harrowing it into the seed bed? and, (ii) if deep placement is not to be adopted is it better to broadcast the fertilizer and harrow it into the seed bed, or to place the fertilizer in bands or pockets close to the seed by the use of some such device as a combined seed and fertilizer drill?

The first of these two questions is bound up with a further point, namely, time of application, for ploughing is usually done some time before the final preparation of the seedbed. The advocates of ploughing-in point to the large root development in the lower layers of the soil, and their moister nature as compared with the top 2 or 3 inches, the maximum depth to which fertilizer broadcast on the surface of the ground is likely to be carried down by the cultivations done in the preparation of a seedbed for most crops. Against this must be set the possible loss of fertilizer by washing out, especially with a nitrogenous fertilizer, if the ploughing is to be done during the autumn or early winter. This risk tends to restrict the possibilities of ploughing-in to fertilizers supplying only phosphate or potash. There is also the point that phosphate is particularly valuable to many crops in their seedling stage. To bury the whole of the phosphatic fertilizer deep in the soil might lead to a rather inadequate supply for the seedling, and to consequent slow growth in the early stages, with the attendant risk of prolonged exposure to the attack of insect pests. Though this difficulty could be overcome by ploughing in only a portion of the phosphatic fertilizer, few farmers

would welcome the idea of splitting the dressing in this way until very definite advantages have been shown.

In the comparison of the merits of broadcasting and of sowing with a combined seed and manure drill, it must be remembered that the latter can concentrate the fertilizer near the seed and also save traversing the same ground twice over —once with a fertilizer distributor and again with the seed drill. On the other hand, however, there is the possibility that injury may result to the germinating seed from the too close proximity of an unsuitable fertilizer, this risk being most serious under prolonged dry soil conditions.

Whether or not it is always possible to increase yields or, alternatively, to obtain the same yield from a smaller quantity of fertilizer by placing the fertilizer in some particular position in the soil, must depend on a variety of circumstances. That it is possible to do so under some conditions has already been shown in this country as well as abroad. There is also, however, the wider question of the effect on subsequent crops and on the plant food reserves in the soil. Even if, by correct placement, the yield of the first crop can be maintained with a reduced amount of fertilizer, it may be necessary to increase the usual application to the succeeding crop, since presumably there will be a smaller residue left from the first application. Hence the saving in fertilizer may be less than seems probable at first sight.

It must be admitted, however, that under ordinary conditions, the actual recovery of fertilizer, especially phosphate and potash, is only a small percentage of the amount applied. Phosphate and potash, in the form of soluble fertilizer, are soon "fixed" by most soils in forms that are only slowly available to growing crops. It has been suggested that the concentration of the fertilizer in "pockets" may protect the centre of the "pocket" from contact with soil, thereby maintaining the plant food in a more readily available condition for a longer period of time, and causing a larger proportion of the fertilizer to be utilized by crops. Alternatively, the concentration of fertilizer in certain parts of the soil may enable the young roots to make better use of it, facilitating the rapid uptake of plant food just when it is most required by the plant. Both these suggestions seem contrary to the older views on the importance of distributing the fertilizer uniformly throughout the soil. Nevertheless, if there is any chance that, by careful placement, the present apparently

low efficiency can be increased, this should certainly be investigated.

American experiments suggest that the fertilizer should be separated from the seed by 2 or 3 inches of soil, a result that can be achieved with certain types of drill. This view has not yet been confirmed by actual experiments in this country, though it does seem probable that a thin layer of soil between seed and fertilizer may reduce the risk of injury to germination, if nothing else.

Considerable use of combined seed and fertilizer drills has been made on mechanized cereal farms with apparently satisfactory results. In such instances, however, the fertilizer dressing is not usually heavy. In this connexion it must be remembered that delivery per coulter, or quantity per unit length of row, is the important factor and this will, of course, vary with the row-width for any given quantity per acre.

Farmers who do not possess a combined seed and manure drill sometimes mix fertilizer and seed together, and sow the mixture with the ordinary seed drill. This has often proved satisfactory, especially with a granular type of fertilizer having granules of similar size to the seeds. By this method, however, the fertilizer and seed are sown in very close contact and the quantity of fertilizer used should be kept small. Further, seed and fertilizer should not remain long in contact with one another before sowing. Hence it is best to mix them as near as possible to the actual time of sowing, and thereby reduce the risk of injury to germination if, for any reason such as the onset of wet weather, drilling has to be postponed.

Though it may sometimes be an advantage from the practical standpoint to sow seed and fertilizer simultaneously, direct evidence of an increase in yield or economy in fertilizer over the commoner practice of separate distribution, is insufficient to warrant the universal adoption of the method at present, though further study of the problem seems well worth while, especially if there is any likelihood that the suggested increase in the efficiency of the fertilizer can be substantiated.

Nutrition and Cropping. Biennial bearing in the apple is a troublesome problem to many fruit growers, though there is now a strong body of opinion that it is closely related to the nutrition of the tree, and often can be overcome by liberal balanced manurial treatment.

The tomato affords another instance of this irregular type of cropping, the exhaustive effects of the fruit borne by the early trusses restricting vegetative activity until the major portion of this fruit is reaching maturity. The results of investigations* at the Cheshunt Experimental and Research Station, into the effect of nitrogen and potash on the fruiting of tomatoes, are of particular interest in relation to this question of uneven cropping.

Experiments showed that, on plants receiving complete fertilizer treatment, the percentage of blossom buds that opened decreased considerably as the season advanced, reaching a minimum value of 45 per cent. for the sixth truss, a fact that suggests competition for nutrient supply with the developing fruits of the second, third and fourth trusses.

All plants also showed an increase in the time interval between the opening of adjacent blossoms until a maximum was reached, after which the interval gradually decreased. The longest time interval for plants receiving complete fertilizer corresponded with the final stages of maturation of the fruit on the second, third and fourth trusses.

The effect of low nitrogen supply in reducing the weight of the crop was most pronounced at the mid-season period of heavy fruiting, whilst low potash led to a progressively more serious effect as the season advanced. The familiar mid-season check corresponded to the period of maximum weight of developing fruit, and was attributed to competition for nutrient supply between fruit and vegetative parts of the plants. This check was accentuated by both nitrogen and potash starvation, though nitrogen starvation had the most serious effect on growth, crop yield at the fifth and sixth trusses and proportion of "retarded" fruits on the second, third and fourth trusses.

It seems as if the mid-season check is associated with a general low level of nutrition, a similar theory to that already mentioned in relation to biennial bearing in apples. Favourable growth conditions at the time when the second, third and fourth trusses unfold result in a large number of fruits setting in a short period, and a consequent large increase in the demand for nutrients until this exceeds the available supply. White suggests that the basal fruits of the trusses can actually monopolize the nutrient supply, thereby causing cessation of vegetative growth, including the develop-

* H. L. White. *Ann. App. Biol.*, **25**, p. 20.

ment of further flower trusses and of the apical fruits of the existing trusses.

Further growth, and the development of new flower trusses, can take place only when the existing fruit no longer requires all the nutrient supplies, i.e., as it approaches maturity. As a practical measure for reducing the mid-season check, it is suggested that the number of fruits on the lower trusses should be restricted to those likely to reach good size and quality. Improvement in the nutrient supply may also be obtained by the application of a suitable top dressing of fertilizer when the fifth truss can be seen. The composition of this top dressing should be very carefully considered. A full discussion of this point is given in the Ministry's Bulletin 77.*

Artificial Fertilizers and Soil Productivity. In concluding these Notes for the current season it may be worth while referring to one or two general aspects of the use of fertilizers. The frequent references that have been made to artificial fertilizers should not be taken as indicating any lack of appreciation of the value of dung and of other means of supplying the large amounts of organic matter necessary to maintain the humus content of the soil. It is quite clear, however, that artificial manures do afford great scope for improving crop yields when used intelligently and in conjunction with farmyard manure, sheep folding, or other means of maintaining the humus and fertility of the soil. On the other hand, it is just as easy to waste a lot of money by the purchase of fertilizers not suitable for the purpose for which they are to be used.

Many farmers follow a well balanced programme of manuring in which artificial fertilizers are used to supplement the other sources of plant food, and in which the wider meaning of soil fertility is not forgotten. Unfortunately, however, there are still many farmers who use little or no artificials, and so fail to gain the full benefit from their careful tillage, or from the dung they apply. Again, there are farmers who sometimes expect an application of artificial fertilizer to produce a high yield from a crop that, by reason of poor tillage, bad drainage, or bad farming, never had a chance at the outset.

It is entirely wrong, and often unprofitable, to use artificial fertilizers primarily in an attempt to make up for bad cultiva-

* Bulletin No. 77, *Tomatoes.* Price 1*s.* 6*d.* (by post 1*s.* 8*d.*).

tion. They will sometimes convert a partial failure into a passable crop, but in the absence of proper cultivation an application of artificial fertilizer can, as a rule, only lead to disappointment.

The first principle in cultivation is the treatment of the soil to ensure that it is in the best possible physical condition to maintain the necessary moisture supply to the crop, for seeds and seedlings to germinate and grow quickly, and for plants to develop a strong and healthy root system with which to take up the necessary plant food from the soil. The second principle should be to *maintain* a good reserve of plant food in the soil, keeping this at a level sufficiently high to grow moderately good crops even if the usual applications of fertilizer have to be temporarily reduced or withheld. In addition to the importance of soil fertility from a national standpoint in a time of emergency, it cannot be too strongly emphasized that, in everyday farming practice, land in good heart stands up to an unfavourable season better than land that has been farmed out, however liberal the application of artificials.

PRICES OF ARTIFICIAL MANURES

Description	Average prices per ton (2,240 lb.) during week ended April 13				
	Bristol	Hull	L'pool	London	Cost per Unit ¶
	£ s	£ s	£ s	£ s	s d.
Nitrate of Soda (N 15½%) *	8 0c	8 0c	8 0c	8 0c	10 4
,, ,, Granulated (N 16%) *	8 0c	8 0c	8 0c	8 0c	10 0
Nitrate of Lime (N. 13%) *	7 7e	7 7e	7 7e	7 7e	11 4
Nitro-Chalk (N. 15½%) . .. *	7 10c	7 10c	7 10c	7 10c	9 9
Sulphate of Ammonia — Neutral (N 20·6%) .. *	7 14c	7 14c	7 14c	7 14c	7 6
Calcium Cyanamide (N. 20·6%) *	7 16d	7 16d	7 16d	7 16d	7 7
Kainite (Pot. 14%) . §	2 18	2 15	2 15	2 15	3 11
Potash Salts (Pot 30%) §	5 4	5 1	5 0	5 1	3 5
,, ,, (Pot. 20%) §	3 15	3 12	3 12	3 12	3 7
Muriate of Potash (Pot 50%) §	8 10	8 8	8 5	8 8	3 4
Sulphate ,, (Pot 48%) §	10 2	10 0	9 17	10 0	4 2
Basic Slag (P A 15¾%) . §	2 12b	2 5b	—	2 10b	3 2
,, ,, (P A (14%) . §	2 8b	2 0b	2 0b	2 6b	3 3
Grd Rock Phosphate (P A 26–27½%) .. .. §	3 7a	3 2a	2 18a	2 12a	2 0
Superphosphate (S P A 16%) . §	3 4	—	3 5f	3 2g	3 11
,, (S P A 13¾%) §	3 1	2 17	3 2f	2 19g	4 3
Bone Meal (N 3¾%, P A 20½%) §	—	7 5	7 5h	6 17	—
Steamed Bone Flour (N ¾%), P A 27½–29½%) . .. §	5 5i	5 5	4 15h	4 10	—

Abbreviations N = Nitrogen, P A = Phosphoric Acid; S P.A = Soluble Phosphoric Acid, Pot = Potash.

* Prices are for not less than 6-ton lots, at purchaser's nearest railway station, unless otherwise stated Unit values are calculated on carriage-paid prices

§ Prices are for not less than 2-ton lots, nett cash for prompt delivery f.o r in town named, unless otherwise stated Unit values are calculated on f o r prices

a Prices for 4-ton lots f o r Fineness 85% through standard sieve

b Prices for 6-ton lots. Prices at Bristol are f o r. Bridgwater, at Hull and Liverpool f o r neighbouring works, and at London f o r at depots in London district. Fineness 80% through standard sieve

c For lots of 4 tons and under 6 tons the price is 1*s* per ton extra, for lots of 2 tons and under 4 tons, 5*s* per ton extra, and for lots of 1 ton and under 2 tons, 10*s* extra

d Delivered in 5-ton lots at purchaser's nearest railway station For lots of 2 tons and under 5 tons the price is 5*s* per ton extra, for lots of 1 ton and under 2 tons, 10*s*. per ton extra and for lots of 4 cwt. and under 1 ton, 20*s*. extra.

e For lots of 4 tons and under 6 tons the price is 1*s*. per ton extra, for lots of 2 tons and under 4 tons, 5*s* per ton extra, for lots of 1 ton and under 2 tons 7*s*. 6*d*. per ton extra, and for lots of under 1 ton, 20*s* extra

f Prices shown are f o r Widnes

g Prices shown are ex works London, f o r southern rails, 1*s*. 3*d* extra

h Prices shown are f.o r Appley Bridge.

i Price shown is f.o.r Newport, Mon.

¶ *These are calculated by regarding a ton as comprising* 100 " *units* " (*equal parts of* 22·4 *lb.*) *so that a fertilizer, for example, with* 16 *per cent. nitrogen, contains* 16 *such* " *units* " *in a ton. Then, if the price per ton of such a fertilizer be divided by the percentage figure, the deduced cost is that of a* " *unit* " *of that agent. Those in the table above are based on London prices.* (*For further explanation, see Advisory Leaflet No.* 146, " *The Valuation of Artificial Manures* " *obtainable from the Ministry, free of charge*)

NOTES ON FEEDING

CHARLES CROWTHER, M.A., Ph.D.,
Harper Adams Agricultural College

Storage of Dried Grass. The development of the artificial drying of grass has made familiar the fact that one of the important nutritive qualities of grass (and greenstuff generally) is the presence in it of certain pigments of the carotene group, which, when ingested, are converted into vitamin A in the animal body. The vitamin itself is a nearly colourless substance and does not occur as such in the grass, the vitamin-A value of which therefore depends upon its content of the carotenes out of which the vitamin is formed.

The dominant pigment of the grass is, of course, the green chlorophyll, and other pigments are also present that have no relation to vitamin A, so that the colour of grass—and incidentally also the colour it imparts to milk—is not a safe guide to its vitamin potency, although it may serve as a rough criterion for practical purposes.

The carotenes are reddish-yellow crystalline compounds, which are complex hydrocarbons in chemical character. Four different carotenes that are capable of giving vitamin A have been isolated, the most effective being the one known as beta-carotene, which has twice the vitamin-producing value of the others. The vitamin potency of a particular sample of grass thus depends not only upon the total carotene content, but also upon the proportion of the different forms present.

Unfortunately, both carotene and vitamin A are very readily oxidized, even at ordinary temperatures, and grass therefore tends to lose a great part of its original carotene content under the prolonged exposure involved in ordinary hay-making even under the best conditions, whilst, under the worst conditions, the carotene may disappear entirely. If the grass be ensiled, the loss of carotene is much less owing to the more restricted possibilities of oxidation in the silo. The most effective conservation of the carotene is obtained by putting the grass through the grass drier, since, although carotene oxidizes more quickly at high than at low temperatures, the time during which the grass needs to be exposed to the high temperature is so short that very little loss takes place.

Dried grass, as it comes fresh from the drier will thus

contain practically all the carotene of the original grass as cut. During storage, however, a slow destruction (oxidation) of the carotene takes place, the rate of which will vary according to the conditions of storage, and possibly other factors, so that by the time the dried grass is fed to stock its carotene content (and therefore its vitamin value) may have been appreciably reduced.

This problem of deterioration in carotene content (and vitamin potency) of green fodders during drying and storage has been studied at various centres in the United States, especially with dried alfalfa (lucerne) and timothy grass. Tests in New Jersey showed a loss of 80 per cent. of the carotene in alfalfa during the first 24 hours of drying in the field, and similar losses were found elsewhere. Thus in an investigation carried out by the U.S. Department of Agriculture it was found that commercial alfalfa hays frequently contained only one-tenth to one-fifth as much carotene as is ordinarily found in the growing plant. In other experiments, the loss was found to be much less from dried alfalfa kept in the dark, than from similar material exposed to sunlight for the same length of time at the same temperature. Even in the dark, however, the loss may be substantial in the warmer part of the year. Thus in one example three sun-dried hays lost 9 per cent. of their carotene from November to April, and 30 per cent. from April to August.

Excess of moisture in the stored material also tends to increase the destruction of carotene, and any evidence of fermentation, such as lumpiness or musty odour, is sure to indicate considerable loss.

Grinding often tends to increase the rate of loss, both in the preparation of the meal and during subsequent storage. In American experiments in which hays were ground to a fine powder in a ball mill, about 25 per cent. of the carotene on the average was lost during grinding and there was a further rapid loss during storage. The losses were much reduced, however, when the hays were ground less finely in a different type of mill.

The latest American contribution is contained in a recent Department of Agriculture report dealing with the rate of loss of carotene and of colour from alfalfa, timothy and clover hays and meals during storage. On the average, the rates of loss in the three materials under comparable conditions were much the same, so that a summary of the combined

results will suffice to indicate the general character of the results. The experiments were carried out at the Department's Experimental Station at Beltsville, in Maryland, so that the results may be considered as applicable strictly only to the local climatic conditions of that area, but applied with discretion they should furnish useful guidance to the probabilities of loss under other conditions.

Twenty-two samples of baled hays that were stored in a "rather dark, unheated barn loft," when the outside temperature was 7.2°C. (45°F.) or less (as in December, January, February, and frequently in November and March), lost on an average about 3 per cent. of their carotene content per month. With 34 samples of hay that were similarly stored when the average outdoor temperatures ranged from 7.2°C. to 18.9°C. (66°F.), as in April, May and October, the average loss of carotene was 6.5 per cent. per month. At outside temperatures above 18.9°C., the loss of carotene during storage increased greatly.

For six samples of hay that were stored during the first summer after cutting, the loss was 21 per cent. per month; and for three samples stored further for a second summer it was about 11 per cent. per month.

Meals from alfalfa ground to pass $\frac{1}{8}$-, $\frac{1}{4}$-, and $\frac{3}{4}$-in. mesh screens lost carotene at the same rate during storage regardless of the degree of fineness of grinding, and at practically the same rate as the corresponding baled samples of hay.

With both hays and meals stored as in this series of tests, the percentage rate of loss of carotene was much more rapid than that of their natural green colour, a fact that should therefore be kept in mind when judging the carotene content or vitamin-A potency of stored hay or dried grass from its colour.

The practical application arising from these various observations is that, from the point of view of conservation of its carotene content, dried grass should be made with a minimum moisture content to deter bacterial action, and should be stored if possible in a cool place protected from sunlight.

Storage of Carotene and Vitamin A in the Body. The conversion of carotene into vitamin A takes place only in the animal body. The extent of this conversion varies with the species, being apparently more complete in rats, pigs, sheep and goats than in cattle and poultry. The organ chiefly

concerned appears to be the liver, and it is mainly here that any surplus of the carotene or vitamin is stored. In those species of animals in which the conversion to vitamin is only partial a relatively large reserve of carotene can be built up when the diet is rich in the pigment, out of which the needs of subsequent periods of carotene scarcity in the diet can be met. In American experiments (Guilbert & Hart, 1935) the total storage of carotene and vitamin A in the liver and reserve fat of cows given a carotene-rich ration throughout life was estimated to be 0.6-0.7 grm. for the younger animals and up to 3.6 grm. in old cows. From 67 to 93 per cent. of the storage was in the liver, mostly in the form of vitamin A, whereas carotene predominated in the portion stored in the depot fat. In these experiments it was found to require more than 200 days to deplete the livers completely of the store of carotene and vitamin A derived from a previous dietary rich in carotene.

This power of storage eliminates the necessity for a constant daily supply of the vitamin or carotene in the diet, so that short periods of scarcity are of no practical consequence. Animals on good pasture, for example, can store during the grazing season extensive reserves that later help to meet their needs during the winter feeding period when, as frequently happens, their rations may be deficient. It is common experience in the management of dairy herds that difficulties are more apt to arise in the closing than in the earlier parts of the winter period, and the possible association of some of these troubles with vitamin-A deficiency should be kept in mind.

That among cattle there are marked breed differences in the ability to convert carotene into vitamin A, is reflected in the difference in colour of the body fats and of the milk fats, as for example between Shorthorns and Jerseys. The latter are less efficient converters of the coloured carotene into the colourless vitamin A, and consequently more unchanged carotene finds its way into the fats. Despite the higher colour and carotene content of the butter-fat from the Guernsey or Jersey cow, it is on the average no richer in vitamin A than the much paler butter-fat from similarly fed cows of the other breeds. This does not preclude the possibility that, owing to the higher fat content, a given weight of milk from the Channel Islands breeds may supply more vitamin A than the same weight of normal Shorthorn, Ayrshire or Friesian milk.

On this point it should be noted that the vitamin-A value of milk is entirely dependent upon the amount present in the feed, supplemented by any reserve in the liver, so that very large variations in the vitamin potency of the milk may occur. The amount there found may be several times as great on feeds high in carotene as on carotene-poor feeds. The proportion of the feed carotene that appears as vitamin A in the milk is, however, at best only very small. In American experiments (Russell & others, 1935), in which very high concentrations were fed, the output of vitamin in the milk never exceeded 3½ per cent. of the intake, although in other experiments with much lower intakes recoveries up to 10 per cent. have been reported. It would appear that there is a maximum milk potency that cannot be exceeded by further intakes of vitamin A or carotene, and that this maximum level is probably reached on good pasture.

Experiments carried out a few years ago at Cambridge with rats suggest that there is a similarly severe limitation to the possibilities of ensuring through the pregnant mother's diet that her offspring will be born and weaned with an adequate store of vitamin.

Similar conditions apparently apply to the transmissibility of carotene and vitamin A from the food of the hen to her eggs. Experiments at Cambridge on this point have demonstrated that the addition of vitamin A to a diet poor in the vitamin and carotene may raise the vitamin-A content of the egg considerably, but, even at a level of supply that apparently exceeded the limits of absorption by the intestine, the proportion of the vitamin consumed that reached the eggs did not exceed 2 per cent. Post-mortem examination of the birds revealed a relatively high concentration of vitamin A in the livers; a much lower, but still considerable, storage in the kidneys, but no more than negligible traces in the other organs examined. It would appear, therefore, that the storage rôle of the liver in vitamin-A economy is essentially the same in the bird as it is known to be in the mammal.

Description	Price per ton		Manurial value per ton		Cost of food value per ton		Starch equiv. per 100 lb.	Price per unit starch equiv.		Price per lb. starch equiv.	Protein equiv.
	£	s.	£	s.	£	s		s	d.	d.	%
Wheat, British.. ..	7	12	0	9	7	3	72	2	0	1·07	9·6
Barley, British Feeding	8	0§	0	9	7	11	71	2	2	1·16	6·2
" Canadian No. 3 Western	8	2	0	9	7	13	71	2	2	1·16	6·2
" American ..	8	8†	0	9	7	19	71	2	3	1·21	6·2
" Argentine ..	8	2	0	9	7	13	71	2	2	1·16	6·2
" Persian ..	8	0	0	9	7	11	71	2	2	1·16	6·2
" Russian ..	8	8*	0	9	7	19	71	2	3	1·21	6·2
Oats, English, white ..	8	13	0	10	8	3	60	2	9	1·47	7·6
" " black and grey	8	13	0	10	8	3	60	2	9	1·47	7·6
" Scotch, white ..	8	15	0	10	8	5	60	2	9	1·47	7·6
" Canadian— No. 2 Western..	10	7*	0	10	9	17	60	3	3	1·74	7·6
" No. 3 Western .	8	3§	0	10	7	13	60	2	7	1·38	7·6
" Mixed feed .	8	0	0	10	7	10	60	2	6	1·34	7·6
" No. 1 feed .	9	7*	0	10	8	17	60	2	11	1·56	7·6
" Argentine ..	8	17	0	10	8	7	60	2	9	1·47	7·6
Maize, American .	7	2	0	7	6	15	78	1	9	0·94	7·6
" Argentine ..	8	0	0	7	7	13	78	2	0	1·07	7·6
" South African, No. 2 White Flat	7	2†	0	7	6	15	78	1	9	0·94	7·6
Beans, English, Winter	7	15§	0	18	6	17	66	2	1	1·12	19·7
Peas, English, blue ..	12	10§	0	16	11	14	69	3	5	1·83	18·1
" Japanese ..	18	10†	0	16	17	14	69	5	2	2·77	18·1
Dari	7	18†	0	8	7	10	74	2	0	1·07	7·2
Milling Offals—											
Bran, British ..	7	10	0	17	6	13	43	3	1	1·65	9·9
" Broad.. ..	8	0	0	17	7	3	43	3	4	1·79	10·0
Middlings, fine, imported	7	10	0	14	6	16	69	2	0	1·07	12·1
Weatings‡	7	7	0	15	6	12	56	2	4	1·25	10·7
" Superfine‡	7	15	0	14	7	1	69	2	1	1·12	12·1
Pollards, imported ..	7	5	0	15	6	10	50	2	7	1·38	11·0
Meal, barley	9	2	0	9	8	13	71	2	5	1·29	6·2
" " grade II	8	7	0	9	7	18	71	2	3	1·21	6·2
" maize	7	15	0	7	7	8	78	1	11	1·03	7·6
" " South African	7	0	0	7	6	13	78	1	8	0·89	7·6
" " germ ..	7	5	0	12	6	13	84	1	7	0·85	10·3
" locust bean ..	7	15	0	6	7	9	71	2	1	1·12	3·6
" bean	9	7	0	18	8	9	66	2	7	1·38	19·7
" fish (white) ..	15	0	2	6	12	14	59	4	4	2·32	53·0
" Soya bean (extracted)‡	9	2	1	12	7	10	64	2	4	1·25	38·3
Maize, cooked, flaked	8	0	0	7	7	13	84	1	10	0·98	9·2
Linseed cake—											
English, 12% oil ..	10	12	1	2	9	10	74	2	7	1·38	24·6
" 9% " ..	10	0	1	2	8	18	74	2	5	1·29	24·6
" 8% " ..	9	15	1	2	8	13	74	2	4	1·25	24·6

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Cottonseed cake—English, Egyptian seed, 4½% oil ..	5 5	0 19	4 6	42	2 1	1·12	17·3
Cottonseed cake—Egyptian, 4½% oil	5 0	0 19	4 1	42	1 11	1·03	17·3
Cottonseed cake, decorticated, 7–8% oil	7 15†	1 10	6 5	68	1 10	0·98	34·7
Cottonseed meal, decorticated, 7–8% oil	8 2†	1 10	6 12	70	1 11	1·03	36·8
Coconut cake, 5% oil	7 15†	0 19	6 16	77	1 9	0·94	16·4
Ground nut cake, 6–7% oil	7 0*	1 0	6 0	57	2 1	1·12	27·3
Ground nut cake, decorticated, 6–7% oil	8 7*	1 10	6 17	73	1 11	1·03	41·3
Ground nut cake, imported decorticated, 6–7% oil	7 0	1 10	5 10	73	1 6	0·80	41·3
Palm-kernel cake, 4½–5½% oil	7 10†	0 13	6 17	73	1 11	1·03	16·9
Palm-kernel cake meal, 5½% oil	7 15†	0 13	7 2	73	1 11	1·03	16·9
Palm-kernel meal, 1–2% oil	7 0	0 13	6 7	71	1 9	0·94	16·5
Feeding treacle ..	5 0	0 9	4 11	51	1 9	0·94	2·7
Brewers' grains, dried ale	6 15	0 12	6 3	48	2 7	1·38	12·5
Brewers' grains, dried porter	6 7	0 12	5 15	48	2 5	1·29	12·5

* At Bristol § At Hull. † At Liverpool.

‡ In these instances manurial value, starch equivalent and protein equivalent are provisional.

NOTE: The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of March, 1938, and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative values of the feeding stufis on offer at their local market by the method of calculation used in these notes. Thus, if linseed cake is offered locally at £11 per ton, then since its manurial value is £1 2*s*. per ton as shown above, the cost of food value per ton is £9 18*s*. Dividing this figure by 74, the starch equivalent of linseed cake as given in the table, the cost per unit of starch equivalent is 2*s*. 8*d*. Dividing this again by 22·4, the number of pounds of starch equivalent in one unit, the cost per lb. of starch equivalent is 1·43*d*. Similar calculations will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own markets. The figures given in the table under the heading manurial value per ton are calculated on the basis of the following unit prices:—N., 7*s*. 9*d*.; P_2O_5, 2*s*. 7*d*.; K_2O. 3*s*. 8*d*.

The Agricultural Index Number, March, 1938

The general index number of prices of agricultural produce for March at 126 (base, March, 1911-13=100) is again 4 points lower than the previous month, and also 4 points below that recorded for March, 1937. If allowance be made for payments under the Wheat Act, 1932, and the Livestock Industry Act, 1937, the revised index for the month becomes 131. Compared with February, average prices of poultry advanced, those of oats, fat sheep, bacon pigs, cheese, potatoes and hay were practically unchanged, while price movements of other commodities used in compiling the general index were downwards.

Monthly index numbers of prices of Agricultural Produce. (Corresponding months of 1911–12 = 100)

Month	1933	1934	1935	1936	1937	1938
January	107	114	117	119	130	134
February ..	106	112	115	118	129	130
March .	102	108	112	116	130	126
April	105	111	119	123	140	—
May	102	112	111	115	133	—
June	100	110	111	116	131	—
July..	101	114	114	117	131	—
August	105	119	113	119	133	—
September . .	107	119	120	127	137	—
October	107	114	113	125	131	—
November . ..	109	114	113	125	133	—
December ..	110	113	114	126	132	—

Revised monthly index numbers of prices of Agricultural Produce, allowing for payments under the Wheat Act (*a*) *and for the Cattle subsidy* (*b*).

Month	1933	1934	1935	1936	1937	1938
January .	111	119	124	125	133	138
February . .	110	117	122	123	133	135
March .	106	112	118	122	134	131
April .	109	116	126	128	143	—
May . .	105	116	117	120	136	—
June .	104	114	117	121	134	—
July .. .	104	117	120	121	134	—
August ..	108	122	120	124	136	—
September ..	111	125	128	133	142	—
October	112	121	119	129	134	—
November .. .	113	120	119	129	137	—
December	114	120	120	130	136	—

(*a*) Commenced August, 1932. (*b*) Commenced September, 1934.

In the following table the monthly index numbers of prices of individual commodities are shown for the months of December, 1937, to March, 1938, March, 1937, and March, 1936; base, the corresponding months of 1911-13=100.

Commodity	1938			1937		1936
	Mar.	Feb.	Jan.	Dec.	Mar.	Mar.
Wheat	104	109	114	116	121	84
Barley	153	156	165	160	124	96
Oats..	119	119	124	119	115	84
Fat cattle ..	117	121	123	113	102	93
„ sheep	118	122	133	131	145	115
Bacon pigs .	129	132	134	131	122	112
Pork „	133	135	140	139	124	117
Eggs . .	116	122	120	121	121	109
Poultry	136	130	133	130	123	120
Milk..	171	181	181	181	171	171
Butter .	105	105	105	110	100	95
Cheese .	119	121	125	120	110	97
Potatoes . ..	138	140	142	152	200	193
Hay .	77	76	77	79	101	81
Wool . .	104	115	122	117	130	96
Dairy cows .	120	123	123	121	111	102
Store cattle .	123	123	119	112	105	92
„ sheep .	99	102	113	112	117	102
„ pigs	143	151	164	159	129	123

Revised index numbers due to payments under the Wheat Act and to the Cattle subsidy

Wheat . ..	134	134	135	135	134	122
Fat cattle .. .	132	136	138	127	117	107
General Index ..	131	135	138	136	134	122

Grain. Wheat, at 7*s.* 9*d.* per cwt. averaged 4*d.* lower on the month and the index declines by 5 points. If the deficiency payment under the Wheat Act, 1932, is taken into account the index is 134. Barley also was reduced in price, averaging 6*d.* less at 12*s.* 1*d.* per cwt., and the index falls by 3 points. Oats were unchanged at 8*s.* 5*d.* per cwt. and the index remains at 119. In March, 1937, wheat averaged 9*s.*, barley 9*s.* 10*d.* and oats 8*s.* 2*d.* per cwt.

Live Stock. Quotations for second quality fat cattle declined by 8*d.* to 41*s.* 3*d.* per live cwt. and the index falls from 121 to 117. If the subsidy under the Livestock Industry Act, 1937, is added, the index becomes 132. Average prices of second quality fat sheep were unchanged at 9¾*d.* per lb.

but, owing to a rise in the base months, the index declines by 4 points. Bacon pig prices at 12*s.* 11*d.* per score (20 lb.) also were unaltered but, with an upward movement occurring in the corresponding period of 1911-13, the index is 3 points lower. Porkers averaged 3*d.* less at 14*s.* 1*d.* per score (20 lb.) and the index is reduced by 2 points.

Prices of dairy cows were lower than in February, the index moving downwards by 3 points. Store cattle, sheep and pigs were all dearer during the month under review. Increases in prices were, however, also recorded in the base months and the index for store cattle is maintained at 123, while those for store sheep and pigs are lower by 3 and 8 points respectively.

Dairy and Poultry Produce. The regional price of liquid milk declined by 1d. per gallon and the index recedes by 10 points. Butter, at 1*s.* 3*d.* per lb., averaged ¼*d.* less than a month ago but, a similar fall having taken place in the base price, the index continues at 105. Eggs, at 9*s.* 9*d.* per 120, were reduced by 4*s.* 2*d.*, the index moving downwards by 6 points. Quotations for cheese were slightly lower at £4 9*s.* 6*d.* per ton and the index declines by 2 points. All classes of poultry were quoted higher and the combined index appreciates by 6 points.

Other Commodities. The average price of potatoes was little changed at £5 8*s.* 6*d.* per ton but, with a small increase occurring in the base months, the index falls by 2 points. Quotations for both clover hay at £3 17*s.* and meadow hay at £2 15*s.* per ton were somewhat lower; meadow hay, however, showed a more pronounced decrease in the months of March, 1911-13 and the combined index for hay is 1 point higher. The average price of wool declined from 1*s.* 2⅝*d.* to 1*s.* 1⅜*d.* per lb. and the index recedes by 11 points.

Importation of Cherries

With the object of preventing the introduction of the Cherry Fruit Fly, the Minister of Agriculture and Fisheries has made an Order under the Destructive Insects and Pests Acts, 1877 to 1927, regulating the importation of cherries into England and Wales during the 1938 season.

Cherries grown in *Spain* will be admitted without restriction until May 18, after which date the importation of Spanish cherries is prohibited.

Cherries grown in *France* will be admitted until May 27 if accompanied by a certificate of origin; after that date the importation of French cherries is prohibited, with the exception of those certified to have been grown within a small district around Honfleur; details of this district are given in the Order.

Cherries grown in *Italy* will be admitted until June 12 if accompanied by a certificate of origin; after that date only those certified to have been grown within the Region of Emilia or the Province of Verona will be allowed to enter; after June 23 the importation of all Italian cherries is prohibited.

Cherries grown in *Germany* will be admitted until June 26 if accompanied by a certificate of origin; after that date no German cherries will be admitted except those certified not to have been grown south of latitude 53°N. or in East Prussia.

Cherries grown in *Hungary* will be admitted until June 9 if accompanied by a certificate of origin; after that date the importation of Hungarian cherries is prohibited.

Cherries grown in any other European country and imported after May 18 must be accompanied by certificates of origin.

Copies of the Importation of Raw Cherries Order of 1938 (S.R. and O., 1938, No. 316) may be obtained from H.M. Stationery Office, price 2*d*. net.

Tests for Grass Driers

It is announced by the Agricultural Research Council that a grant has been made to the Royal Technical College, Glasgow, for the purchase of equipment that will enable the College to undertake the testing of grass driers in any part of Great Britain. The College is also undertaking certain fundamental work on grass drying, with the aid of another grant made by the Council.

The College is now prepared to report upon designs of grass driers, to make complete investigations of grass driers, to undertake performance tests, or, in approved instances, to make special investigations.

Regulations have been prepared governing the conditions under which these tests will be undertaken, and copies may be obtained from Professor William Kerr, Department of Civil and Mechanical Engineering and Applied Mechanics, The Royal Technical College, Glasgow, C.1, to whom all communications should be addressed.

Visits to Rothamsted and Woburn Experimental Stations

Farmers and all interested in agriculture in its practical, technical, or educational aspects are cordially invited to visit the Rothamsted and Woburn plots at any convenient time between the beginning of May and the end of October. Mr. H. V. Garner, M.A. (Camb.), and Capt. E. H. Gregory will be in charge of the demonstrations, and there is ample material at either of the farms to occupy a full day.

The soil at Rothamsted is a heavy loam. The classical fields, laid down from 1843 onwards, form an unequalled demonstration of the effects of fertilizers on wheat, barley, mangolds and meadow hay. The continuous growing of wheat on Broadbalk field is of special interest to those who are now faced with the manurial and cultivation problems arising out of mechanized cereal farming. Modern fertilizer and cultivation problems are being investigated by the new field technique developed at the Station.

These modern experiments are concerned with the manuring of potatoes, sugar-beet, wheat, barley, mangolds, kale, clover and temporary grass. Rotation experiments test various alternative methods of returning cereal straw to the soil; and suitable equipment for the production of these manures is provided. In addition, the effect of green manuring is being examined.

Additional experiments deal with poultry manure and other organic fertilizers, the effects of bare fallowing, and rotary cultivation. Tests of soil fumigants against insect and other pests are in progress. Experiments on various points of pig management are carried out from time to time. Good types of implements are on view at the farm and a complete electrical installation has been added. Grazing trials on the effect of cake feeding on pasture are in progress. If the weather turns out to be too bad to permit of inspection of the fields, the results are available for examination in the Demonstration Room.

The Woburn farm is on light soil. In addition to the classical fields, modern experiments are in progress on potatoes, barley, sugar-beet, kale, lucerne, and straw and green-manure crops. A new long-period experiment comparing rotations based on 3-year leys with purely arable systems is being started.

The Director, Sir John Russell, will be happy to arrange full details with organizations of farmers, farm workers and others wishing to accept this invitation; small groups of farmers are specially welcomed. If possible, arrangements should be made beforehand; but it is recognized that farmers' movements must often depend on the weather, and no farmer need stay away because he is unable to write fixing a date. It is not possible to see both Rothamsted and Woburn in one day.

All communications and requests to visit the Stations should be addressed to the Secretary, Rothamsted Experimental Station, Harpenden. It would be a convenience if ample notice could be given so as to avoid the possibility of dates clashing.

Trials of Potatoes for Immunity from Wart Disease, 1937

The trials which are arranged each year by the Ministry with the object of testing new varieties of potatoes for immunity from Wart Disease, were again conducted in 1937 on the farm of the National Institute of Agricultural Botany, Ormskirk, Lancashire. The actual field operations and the taking of records were carried out by Mr. Harold Bryan, B.Sc., and Mrs. McDermott, of the Institute, but the trials were conducted on a plan approved by the Ministry.

Twenty-five stocks were included in the second and subsequent years' tests; one proved to be a synonym of an existing variety. Of the 32 entries for the first year's tests, 5 proved to be synonyms of existing varieties; 2 were too poor to judge, and 25 were distinct varieties.

As in previous years, the results of the trials have been considered by a small committee composed of representatives of the Ministry of Agriculture and Fisheries, the Department of Agriculture for Scotland and the Ministry of Agriculture for Northern Ireland, and co-ordinated with the results of the trials carried out by the two last-named Departments at Edinburgh and Kilkeel respectively.

The Committee recommended the approval of 24 new varieties, but none of these has actually been added to the approved list, inclusion having been postponed until such time as the raisers intimate that the varieties have actually been or will shortly be introduced into commerce. This intimation has been received in respect of one variety which had been recommended for approval as the result of

trials carried out in previous years and which is now being introduced into commerce: a description of this variety is given below.

The findings of the Potato Synonym Committee of the National Institute of Agricultural Botany have been accepted by the Ministry where recommendations as to the classification of new varieties as synonymous with existing varieties have been made by that Committee.

A list of the names of the more commonly grown varieties which have been approved as immune from Wart Disease may be obtained on application to the Ministry.

EARLY MAINCROP VARIETY—**Topsman**

Sprout.	Pink.
Tuber.	Blunt, thick oval; skin pink, splashed red round the eyes, flesh deep lemon; eyes shallow and on the point.
Haulm and Foliage	Moderately tall, vigorous, upright, bushy, crowded appearance; leaf close, arched; leaflets broad, long, wrinkled and glossy; secondary leaflets large; wings crinkled; stems green.
Flowers	Red-purple, infrequent

Seed Testing Course and Examination

A Seed Testing Course of four weeks' duration, followed by a two days' Examination, will be held at the Official Seed Testing Station, Cambridge, between June 20 and July 21 next. Similar Courses were held during the years 1922-30 and again in 1932 and 1935 but no Course has been held since 1935. It is unlikely that any Course will be held next year.

The fee for the Course and Examination is £6 6*s.* 0*d.*, and for the Examination only £1 1*s.* 0*d.*

Full particulars of the Course can be obtained from the Secretary, National Institute of Agricultural Botany, Cambridge.

Stud Goat Scheme, 1938-39

This scheme for the improvement of milch goats kept by cottagers, smallholders and others is being continued during the forthcoming breeding season, which extends from September 1 to February 28 next. Under this scheme, persons in the above-named categories are enabled to procure the services of first-class stud goats for breeding purposes at a maximum fee of 4*s.* per service. The stud goats used must have been entered, or be considered eligible for entry, in the British Goat Society's Herd Book, and they must have been bred

from milk-producing stock. As in previous years the scheme will be administered by the Society, and owners who wish to have their stud goats registered should make application to the Secretary to the Society, The Cottage, Roydon, Diss, Norfolk, who will be pleased to furnish them with full particulars.

Entries must be received on or before May 20, 1938, and goats submitted for approval must be available for inspection after that date at the premises at which it is proposed that they should stand at stud.

APPOINTMENTS

COUNTY AGRICULTURAL EDUCATION STAFFS: ENGLAND

Cumberland and Westmorland: Miss E M. Woollons has been appointed Assistant Poultry Instructress, *vice* Miss A. R. Pinkerton, N D P.

West Suffolk: Mr. R. P. Hawkins, M.Sc (Agric), N.D A, has been appointed Agricultural Organizer, *vice* Mr R Sayce, B Sc., N.D.A.

FARM WORKERS' MINIMUM RATES OF WAGES

Farm Workers' Minimum Rates of Wages.—A meeting of the Agricultural Wages Board was held at Kings Buildings, Smith Square, London, S.W 1, on March 21, 1938.

The Board considered notifications from Agricultural Wages Committees of decisions fixing minimum and overtime rates of wages, and proceeded to make the following Orders:—

Devonshire.—An Order fixing minimum and overtime rates of wages to come into operation on March 27, 1938 (i e, the day following that on which the existing rates were due to expire) and to continue in force until March 25, 1939. The minimum rates in the case of male workers of 21 years of age and over are 35*s.* 6*d.* (instead of 34*s.*) per week of 43 hours in the weeks in which Good Friday, Easter Monday, Whit Monday and August Bank Holiday fall and 52 hours in any other week in summer, 41 hours in the week in which Boxing Day falls and 50 hours in any other week in winter, with overtime at 9*d.* per hour on weekdays (instead of 8½*d.* per hour) and 11*d.* per hour on Sundays and for all overtime employment on the hay and corn harvests (instead of 10*d.* per hour). The minimum rates for female workers of 18 years of age and over are 7*d.* per hour (instead of 6*d* per hour) per week of 40 hours in the weeks in which Good Friday, Easter Monday, Whit Monday, August Bank Holiday and Boxing Day fall and 48 hours in any other week with overtime unchanged at 7½*d.* per hour.

Durham.—An Order fixing minimum and overtime rates of wages to come into force on May 14, 1938 (i.e., the day following that on which the existing rates are due to expire) and to continue in operation until May 13, 1939. The minimum rates in the case of male workers of 21 years of age and over are, (*a*) horsemen who are householders 35*s.* (instead of 34*s.*) per week of 50 hours with in addition 7*s.* per week to cover all time spent in attention to horses, (*b*) horsemen who are not householders 34*s.* (instead of 33*s.*) per week of 50 hours with in addition 3*s.* 6*d.* per week to cover all time spent in attention

to horses, (*c*) horsemen who are boarded and lodged by their employers 34*s.* (instead of 33*s.* as at present) per week of 50 hours and all time spent in attention to horses, (*d*) stockmen and shepherds, per week of the hours customarily spent in attention to stock—householders 46*s.* (instead of 45*s.*), non-householders 39*s.* 10½*d.* (instead of 38*s.* 10½*d.*), workers boarded and lodged 38*s.* (instead of 37*s.*), (*e*) casual workers unchanged at 6*d.* per hour and (*f*) other male workers 33*s.* (instead of 32*s.*) per week of 50 hours. The overtime rate in the case of all classes of male workers of 21 years of age and over, other than casual workers, is unchanged at 9*d.* per hour except for overtime employment on Saturday afternoon, Sunday, Boxing Day and Good Friday when the rate is 10*d.* per hour. The minimum rates for female workers of 18 years of age and over are 2*s.* 9*d.* (instead of 2*s.* 6*d*) per day of 8 hours with overtime unchanged at 4*d.* per hour.

Kent.—An Order continuing the operation of the existing minimum and overtime rates of wages from April 3, 1938 (i.e , the day following that on which the existing rates were due to expire) until April 1, 1939. The minimum rates in question, in the case of male workers of 21 years of age and over employed wholly or mainly as horsemen, stockmen or shepherds are 35*s.* per week of 42½ hours in the week in which Easter Monday falls, 33 hours in the week in which Boxing Day and December 27, 1938, fall and 52 hours in any other week, and in the case of other male workers of 21 years of age and over, 34*s.* per week of 42½ hours in the week in which Easter Monday falls and 52 hours in any other week in summer; 31 hours in the week in which Boxing Day and December 27, 1938, fall and 48 hours in any other week in winter. The overtime rates in the case of ordinary male workers of 21 years of age and over are 10*d.* per hour on Sundays, Easter Monday, Boxing Day, and December 27, 1938, and 9*d.* per hour for all other overtime employment, and in the case of horsemen, stockmen or shepherds of similar age 10*d.* per hour on Easter Monday, Boxing Day and December 27, 1938, and 9*d.* per hour for all other overtime employment (including Sundays). The minimum rates in the case of female workers of 18 years of age and over are 6*d.* per hour, with overtime at 7*d.* per hour on Sundays, Easter Monday, Boxing Day and December 27, 1938, and 6½*d.* per hour for all other overtime employment.

Sussex —An Order fixing minimum and overtime rates of wages to come into force on April 11, 1938 (i.e , the day following that on which the existing rates were due to expire) and to continue in operation until April 16, 1939. The minimum rates in the case of male workers of 21 years of age and over are for workers employed wholly or mainly as horsemen, cowmen, stockmen or shepherds, 39*s.* 3*d.* (instead of 38*s.* 3*d.*) per week of 50 hours in the weeks in which Good Friday, Whit Monday and December 26, 1938, fall and 58 hours in any other week and for other workers, 34*s.* 3*d.* (instead of 33*s.* 3*d*) per week of 44 hours in the weeks in which Good Friday and Whit Monday fall and 52 hours in any other week in summer; 40 hours in the week in which December 26, 1938, falls and 48 hours in any other week in winter. The overtime rates in the case of all classes of adult male workers are 9½*d.* per hour on weekdays, and 11*d.* per hour on Sundays (instead of 9*d.* and 10½*d.* respectively). The minimum rates of wages for female workers of 18 years of age and over are 5½*d.* per hour (instead of 5*d.*) with overtime unchanged at 6½*d.* per hour on weekdays and 7½*d.* per hour on Sundays.

Radnor and Brecon.—An Order continuing the operation of the existing minimum and overtime rates of wages from May 1, 1938 (i.e., the day following that on which the existing rates are due to expire) until

October 31, 1938. The minimum rates in question in the case of male workers of 21 years of age and over are 33*s*. per week of 48 hours in winter and 54 hours in summer with overtime at 9*d*. per hour. In the case of female workers of 18 years of age and over the minimum rate is 5*d*. per hour with overtime at 6½*d*. per hour on weekdays and 7½*d*. per hour on Sundays.

Enforcement of Minimum Rates of Wages.—During the month ending April 15, 1938, legal proceedings were taken against 10 employers for failure to pay the minimum rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases follow:

Committee Area	Court	Fines Imposed	Costs Allowed	Arrears of Wages ordered	No of workers involved
		£ s d.	£ s d	£ s d.	
Berkshire ..	Wokingham	4 0 0	—	39 0 0	2
" .	"	0 10 0	(*a*)		
Carmarthen	Llanelly ..	2 0 0	—	19 10 7	1
"	" ..	2 0 0	—	4 10 0	1
"	St Clears .	2 0 0	—	6 0 0	1
Cornwall ..	Wadebridge	4 0 0	7 1 6	38 10 0	1
" ..	"	5 0 0	(*b*)		
Glamorgan	Port Talbot	—	7 1 6	15 0 2	2
Oxfordshire	Caversham	20 0 0	1 1 6	53 4 0	2
Yorks (E.R.)	Hornsea ..	0 10 0	1 1 0	7 18 0	1
" ..	Hull .	2 0 0	—	3 7 0	2
Yorks (N.R)	Leyburn ..	0 10 0	—	(*c*)	1
	Totals ..	42 10 0	16 5 6	186 19 9	14

(*a*) Proceedings instituted under Section 9 (3) (B) (Refusing to give information)

(*b*) Proceedings instituted under Section 9 (3) (C) (Producing false documents)

(*c*) Not settled in Court. Arrears to be claimed on hours specified by the Bench

FOOT-AND-MOUTH DISEASE

There have been 42 outbreaks of foot-and-mouth disease confirmed during the period March 21—April 20. Outbreaks that were confirmed at Calne, Wilts, on March 26, at Pen-pedair-heol, Glamorgan, on March 27; at South Wilford, Notts, on April 2; at Birmingham on April 3; at Cumnor, Berks, on April 4, at Ravensden, Beds, on April 5; and at Sheffield on April 7, each necessitated the imposition of Infected Area restrictions on an area extending for approximately 15 miles round the premises on which the disease occurred.

Further outbreaks of the disease were subsequently confirmed in or near to some of the areas referred to above These further outbreaks were as follows:—

In the area around Calne—14 further outbreaks, one of which, viz., that at Pewsey, Wilts, on April 5, necessitated a slight extension of the area.

In the area around Nottingham—2 further outbreaks.

In or near to the area around Birmingham—11 further outbreaks, of

which 4, viz., that at Byfield and West Haddon, Northants, on April 4, that at Barcheston, Warwick, on the same day, and that at Wootton, Northants, on April 8, necessitated extensions of the area.

In the area around Cumnor—1 further outbreak at Taynton, Oxford, on April 8 necessitated a slight extension of the area.

In the area around Ravensden—7 further outbreaks, of which one at Stanwick on April 9 necessitated an extension of the area.

In view of the serious situation arising out of the possibility of wide-spread infection through the exposure in certain markets of animals in an infective state, the Minister decided on April 4 to issue a "Standstill" Order, which applied to all counties in England (except Devon, Cornwall, Cumberland, Durham, Northumberland, Westmorland and Monmouth) (including any county or other boroughs geographically situated therein), but excluded from the area any parts of such counties and boroughs which were for the time being comprised within any Foot-and-Mouth Disease Infected Area for the purposes of the Foot-and-Mouth Disease (Infected Areas Restriction) Order of 1925.

The Order prohibited the movement of animals out of the controlled area, except to places in a Foot-and-Mouth Disease Infected Area contiguous to the controlled area, but permitted the movement of animals into the area from a "free" area or within the controlled area, or from the controlled area to a contiguous Foot-and-Mouth Disease Infected Area, provided that in all cases licences authorizing such movements were obtained from the appropriate Local Authorities. With the exception of markets and sales of animals intended for immediate slaughter, and of farm sales, all markets, fairs, sales and exhibitions of animals in the controlled area were prohibited

An Order revoking the "Standstill" Order as from April 18 was issued on April 13

It has been possible to release the Infected Area around Pen-pedair-heol from restrictions and to contract certain other areas referred to above, and the areas subject to restrictions on April 20 were as follows :—

Wiltshire. A combined area of approximately 15 miles radius around Calne and 5 miles round Pewsey.

Nottingham Five miles around South Wilford and Nottingham.

Northants, Oxford, Warwick, etc. A combined area of 15 miles radius around West Haddon and Woodford Halse, Northants, and Taynton, Oxfordshire, and 5 miles round Barcheston, Warwickshire ; Wootton, Northants , and Cumnor, Berks.

Birmingham. Five miles round Birmingham.

Bedfordshire and Northants. A combined area of 15 miles radius around Ravensden and Bedford, Beds ; Stanwick and Higham Ferrers, Northants.

Sheffield. Fifteen miles around Sheffield. This area was contracted to one of 5 miles round Sheffield on April 22.

WIRELESS TALKS, MAY, 1938

Station and Date	*Time p m.*	*Speaker*	*Subject*
National:			
May 4	6·20	Prof J A Scott-Watson	Sheep Management and the Production of Grass-fed Lamb
,, 11	6·20	Prof J A Scott-Watson	Haymaking
,, 18	12·45	Mr R Gamble	Bee-keeping Bees and Fruit
,, 18	6·20	Prof J A Scott-Watson	Ley Farming
,, 25	6·20	Prof J A Scott-Watson	Science and Tradition in Farming
North:			
May 6	6·40	Messrs J Strachan and T W Featherby	Land Fertility in the Yorkshire Plains
,, 20	6·40	Mr J A Hanley	Grass Drying and Preservation
Midland:			
May 13	7·55	Mr C Norbury	" My Farm Diary "
West:			
May 5	7·50	Mr A Ling	Quarterly Review
,, 12	8·40	,,	For Young Farmers
,, 19	6·40	,,	For Western Farmers
,, 21	9·00	,,	Young Farmers' Competition
Welsh:			
May 6	7·30	Discussion	" Geifr " (Goat Breeding)
,, 20	7 30	Messrs T Lewis and G M Loyn	Honey
Scottish:			
May 5	7·30	Mr R L Scarlett	For Scottish Farmers
,, 12	7·50	Mr W M Mitchell	Breeding and Rearing of Foals
,, 19	8·15	Mr F A Bell	For Scottish Farmers
,, 25	6·30	Discussion	Clean Milk
Northern Ireland:			
May 9	8·20	Mr. P. Fitzpatrick	Farmers' Work and Worry
,, 17	6·40	Rt Hon J Milne Barbour, M P	Royal Ulster Agricultural Show.

NOTICES OF BOOKS

The Pests of Fruit and Hops. By A.M. Massee. D.Sc., F.R.E.S. 294 pp. Frontis., & 26 Plates. (London: Crosby Lockwood. 1937. Price 15*s.*)

The fruit grower's long-felt desire for an up-to-date, well-written and reliable book on insect pests, free from lengthy technical descriptions, is well met by Dr. Massee's publication. In many respects, both in arrangement and matter, it resembles Theobald's *Insect Pests of Fruit*, published in 1908 and out of print for many years and in great need of revision.

There are fifteen chapters, twelve of which have crop titles under which the relative pests are described. Chapter XIII deals briefly with beneficial and harmless insects, Chapter XIV very briefly with insecticides, and the final chapter by J. Turnbull, on the general principles of the modern methods of spraying. Each pest is described in three paragraphs, namely, Recognition in the Field, Notes on Life Cycle, and Control Measures. These are features that will appeal greatly to the grower and student, as the data in the first two paragraphs are largely based on the author's critical personal observations Many of the pests and the damage caused by them can be readily identified by the adequate description assisted by the photographic plates by Mr. Greenslade.

In a book of this type, covering a wide subject in a comparatively small number of pages, it is difficult to include data to satisfy scientific workers, the grower and the student. The control measures are adequate for many needs, but the absence of definitions of the insecticidal materials recommended is disappointing, although this omission is largely met by the careful selected references to modern literature dealing with the details of methods of control

The use of petroleum oils (summer grades) on apples and plums does not receive quite fair treatment, for in practice they have proved valuable spray supplements provided they are used intelligently and with due regard to their limitations.

There are very few errors or oversights in the proof reading, but a stated concentration of 3.0 per cent. nicotine wash on page 245 is one of them (the normal concentration at 8 oz. nicotine to 100 gallons water is equivalent to a concentration by weight of 0 05 per cent.).

The above criticisms do not in any way detract from the undoubted value of the book, which contains, owing to the skill and knowledge of the author, a wealth of data in its 294 pages. A comparison with Theobald's book impresses the reader with the enormous strides made in the control of fruit pests during the past 30 years. Dr. Massee's book has brought the subject up-to-date and it will be invaluable to all who are interested in successful fruit growing.

The Horticultural Note Book. By J. C. Newsham, F.L.S., F.R.H.S. 5th Impression. Pp. xx + 418. (London: The Technical Press, Ltd. 1937. Price 7*s.* 6*d.*)

This new impression of Newsham's well-known book contains much useful information on a variety of subjects appertaining to horticultural practice. The tables are particularly useful and handy for ready reference. The lists of varieties of plants, potatoes, flowers and fruits might with advantage be brought up-to-date by omitting some of the older forms and by including some of the newer varieties now well established in the industry.

The Present Day Rock Garden. By Sampson Clay, M.A., Ph.D. Pp. xxvi + 681, & 56 Plates. (London: T. C. & E. C. Jack, Ltd. 1937. Price 31*s.* 6*d.*)

Further descriptions and new discoveries of desirable Alpine plants have enabled the author to produce a publication that is truly complementary to Reginald Farrer's standard work on *The English Rock Garden.*

The illustrations of the plants *in situ* are particularly fine, and the volume is written throughout in a style that renders it both easy and enjoyable to read.

Sod House Days. Letters from a Kansas Homesteader, 1877–78: written by Howard Ruede. Edited by John Ise. Columbia University Studies in the History of American Agriculture—IV. Pp. xii + 248. (New York: Columbia University Press. 1937. Price 14*s*.)

The galloping cowboy has been a figure of romance from the days of his living until the general dispersion of the cinema throughout the world, but there have been few who have pictured the homely homesteader in any glamorous light. The publication of these letters explains why Kansas was no place to go to if we can believe all that Howard Ruede says, and his story reads as though he were a plain man telling the unvarnished truth. There was no romance in his first experience of homesteading. It was a steady, hard life, remote from even the nearest village, and locomotion was mainly achieved by foot-slogging. A fifteen- or twenty-mile walk in poor shoes on slippery grass or glutinous mud to make a simple small purchase or sale was no joke even for such hardihood as his: the rewards of such privations were to live in a semi-dugout with turf walls raised slightly above ground level and to live on the simplest food, maize meal, beans, bacon if any, and so on. It was little wonder that he was troubled with boils.

These letters were published in the newspaper of Bethlehem, Pennsylvania, the village from which Ruede migrated to the west. Although he himself appears to have been undeterred by the life he found it necessary to lead, the letters contain frequent admonitions to his brother to edit them before they were published in order not to discourage others from following his example. It is easy to understand why he gives the advice. Free land, however, was a sufficient inducement, and the west was rapidly populated in spite of the physical deterrents the pioneers had to meet. Readers of this book will feel that the race of pioneer homesteaders must have been hardy indeed.

Productive Sheep Husbandry. By Walter C. Coffey, Ph.D., 3rd edition revised by William G. Kammlade, Ph D. Pp. xxxii + 479, & 262 Figs. (New York and London: J. B. Lippincott Co. 1937. Price 12*s*. 6*d*.)

The maintenance of soil fertility in the United States of America has become an agricultural problem of national importance. If this is secured by the extension of pasture and forage crops, considerable development in sheep production should result. This book has been revised in the hope that it will aid in this development, and it now forms a complete treatise on sheep husbandry. Although the practice outlined in regard to management and nutrition necessarily relates to American conditions, the work as a whole may be read with profit by British students.

Floristry: A Complete Guide to the Establishment and Management of the Modern Flower Shop. Pp. 99. Illustrated. (London: Lockwood Press, Ltd n.d. 7*s*. 6*d*.)

A modern flower shop is much more than a store for the retailing of flowers—skill and artistry are required in addition to salesmanship The professional "florist artist" is being called upon more and more to render service in social life, and his work includes the making of bouquets, sprays and baskets of flowers, with the necessary wiring and preparation of the blooms, wreath making, table and house decorations—all requiring a high standard of skill. In addition, he must attend to the organization of his business, buy judiciously on the market, dispose of his supplies to

advantage, and please his customer. Sound and clear practical advice on all these aspects of the florist's work and a wealth of detail are given in this book, designed as a text-book for the beginner and a work of reference for the established florist. The difficulties are not under-estimated —" it is one of the easiest trades in the world in which to lose money "— but the possibilities for one who is enthusiastic both in his art and his desire to satisfy, indeed anticipate, the demands of his customers, are well indicated. In future editions the account of flower supplies on the markets might be amplified, while an index would be useful, and the beginner would be interested in particulars of training and apprenticeship available, and in the Royal Horticultural Society's Diploma in Floral Art. These, however, are small points in a book that is happy both in conception and execution, well illustrated and deserving of success.

The Handbook of Modern Pig Farming. By H. M. Rikard-Bell. Pp. 128 & 21 Figs (London: H. F. & G. Wetherby, Ltd. 1937. Price 3*s.* 6*d.*)

The author contends that there is money in pigs, and that they can be made to show a greater percentage of profit on capital invested than any other branch of livestock production; and this book is written to show how such a result can be attained. He discusses the relative merits of the various breeds, systems of management, housing accommodation, feeding—with particular reference to the utilization in a state of emergency of home-grown foods—and common ailments of the pig. The chapter on housing accommodation includes plans, specifications and costs of new houses and converted buildings

The value of this book lies in the very definite recommendations made by the author, suggesting that the conclusions are from the experience of a successful practical pig-keeper, and these conclusions are supported by detailed costs of production and an estimate of profits. The appendix comprises the financial results obtained on a number of farms throughout the country supplemented by the author's comments. This book is recommended to all engaged in or about to start pig-keeping.

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THE JOURNAL OF THE MINISTRY OF AGRICULTURE

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NOTES FOR THE MONTH

Trade Agreement with Eire

The Trade Agreement recently concluded between the United Kingdom and Eire is an integral part of a general Agreement covering also questions of finance and defence. The whole Agreement represents the termination of the six years' dispute between the two Governments and is designed to usher in a period of more friendly relations and closer co-operation between the two countries.

As part of the financial settlement, the special duties imposed on certain agricultural commodities imported from Eire are abolished. It is, however, important to emphasize—as in fact, is realized by the agricultural community in this country—that these duties were in no way intended for the protection of United Kingdom agriculture. Their main purpose was the collection of revenue. In fact, the special duties were not fully protective in most instances on account of the system of countervailing export bounties which was introduced in Eire. It has been arranged that these bounties will also disappear together with the special duties, except as regards one or two individual bounties where the retention of some measure of assistance is required, as stated in Article 15, to the extent that may be necessary to maintain Eire production on an economic basis or to secure the effective operation of a scheme for the orderly marketing of an agricultural product.

Nevertheless, when it was proposed that the special duties should be removed, very careful consideration was given to the position of United Kingdom agriculture which, it was realized, stood in a special relationship to Eire owing to the similarity of Eire production and the proximity of Eire to the United Kingdom market.

Except for certain revenue duties which do not affect

agriculture directly, the Agreement gives Eire goods free entry. As regards eggs, poultry, butter, cheese and other milk products, this undertaking expires in August, 1940. The Agreement provides, however, for measures of quantitative regulation of imports of agricultural products from Eire in association with any arrangements made in this country for the promotion of orderly marketing, and it is not anticipated that there will be any considerable increase in imports in the immediate future.

The quantities of the principal products to be imported from Eire will be settled from time to time in consultation with the Eire Government, probably on an annual basis. As regards fat cattle and beef, supplies will depend on the deliberations of the International Beef Conference, in which Eire will henceforth participate as a full member. It is expected that imports of store cattle during the current year will be about the same as for 1937.

Recognition of the special difficulties of the poultry industry in this country is made by the reservation of powers under Article 4 of the Agreement to control the flow of imports of eggs and poultry. The Government of Eire will assume control of exports to the United Kingdom and will consult, from time to time, with the Government of the United Kingdom as to the quantities to be exported. It is also provided that, should these consultations fail to lead to a satisfactory arrangement, quantitative regulation may be imposed by the Government of the United Kingdom. In this event the two Governments will consult as to the quantities to be admitted into the United Kingdom, or alternatively, duties may be imposed if the two Governments agree that they are more convenient for the purpose in view.

The agreement recognizes the right of either party to impose special protective duties or other import restriction against dumping.

As regards agricultural exports from the United Kingdom to Eire, this trade, though comparatively small, has also been safeguarded. In general, agricultural products receive free entry, some unconditionally, some with a right on the part of the Eire Government to impose quantitative regulation, where necessary, as a counterpart to the similar regulation of Eire goods exported to the United Kingdom. If both Governments agree that it is more convenient to impose duties in lieu of regulation, duties may be imposed on certain other goods and

this course will probably be adopted for a number of horticultural products.

The relatively few agricultural items not covered by the provisions already mentioned will come within the scope of Article 8 of the Agreement, which provides for a review by the Prices Commission (an independent body set up by the Eire Government) of protective duties and other import restrictions, on the principle that such duties and restrictions should be replaced by duties not exceeding such a level as will give United Kingdom producers and manufacturers full opportunity of reasonable competition. United Kingdom producers and manufacturers will have full rights of audience before the Prices Commission.

Generally, the provisions of the Agreement recognize that, in the interests of producers in both countries, it is important that prices of agricultural products in the United Kingdom market should be maintained at a steady level.

The new Trade Agreement came into force on May 19, 1938, and will continue for a period of three years from this date, after which it will be subject to termination at any time provided six months' notice has been given.

Agricultural Returns, 1938

Occupiers of agricultural land will shortly be receiving, if they have not already received, the schedules on which to make their annual return to the Ministry of their acreage under crops and grass, and number of livestock, etc. In order to assist in dealing with points of doubt or difficulty that may arise in connexion with these schedules, the following explanatory note has been prepared.

The Agricultural Returns Act, 1925, empowers the Minister of Agriculture and Fisheries to require all occupiers of agricultural land exceeding one acre in extent in England and Wales to make a return annually of the acreage of land in cultivation, specifying the several crops, the acreage of land in fallow or used for grazing, the livestock on the land, the persons employed, and whether the land is owned. For the purpose of these returns, agricultural land is any land used for the production of agricultural or horticultural crops, and includes land used as grazing, meadow or pasture land, or orchard, and any land used wholly or mainly for the purpose of the trade or business of a market gardener or nurseryman. An agricultural holding may be defined as any

area of such land that is farmed as a separate unit by the occupier thereof, whether the occupier is the owner or tenant.

Returns are required to be made by all persons who occupy more than one acre of agricultural land on June 4, 1938. Occupiers will be receiving their schedule from the Ministry's Crop Reporters on or shortly before that date. With a view to facilitating the tabulation of the returns, every occupier is asked to fill up the schedule and to return it without delay to the Crop Reporter whose address appears on the back of the schedule.

Each occupier will receive a memorandum for guidance in completing the schedule which should be read carefully before the form is filled in, but some of the points that may present difficulty are mentioned here.

It is necessary that returns should be made by occupiers of small areas of pasture land, as well as by occupiers of farms. Such persons have sometimes been in doubt whether they are called upon to furnish returns, on the ground that they are not farmers. The Act makes no provision for the exemption of such occupiers of grass land, and returns could only be omitted if the grass land in question is never used for horses, cattle, sheep, pigs or poultry and no ley crop is taken. The sum total of such small areas must be considerable, and it is necessary that they should be taken into account in arriving at the total agricultural land in the country.

In regard to the distinction between "temporary grass" and "permanent grass," the position is that only grass on land not under rotation should be entered as permanent grass. If, therefore, the occupier has any land laid down to grass—no matter how long ago—he should enter it as "temporary grass" if he intends to plough it up again as part of a rotation. and as "permanent grass" if he intends to leave it down indefinitely.

Confusion sometimes arises in entering in the return particulars of the acreage of orchards and small fruit. There are three items in the schedule:—

Item 33—Orchards with crops, etc., beneath the trees.
Item 34.—Orchards, with small fruit beneath the trees.
Item 35.—Small fruit not under orchard trees.

It is essential that the acreage of any particular area of land should not be entered under more than one of these headings. On the other hand, provision is made in another part of the schedule (Items 98-103) for entering the acreage

of each kind of small fruit, and the total of these (Item 104) should equal the total of Items 34 and 35.

Following similar enquiries in June and December, 1937, the Ministry again desires to obtain information regarding the relative sizes of the beef and dairy herds in the country. Under the headings relating to dairy cattle, occupiers are asked to enter the number of animals used, or intended to be used, solely or mainly for the production of milk, including both milk for sale and milk for consumption on the farm. Animals kept solely or mainly with a view to the production of beef should be entered under the headings relating to beef cattle. It is hoped that these directions will enable occupiers to make the necessary distinction, care being taken that the same animals are not entered twice.

A few changes have been made in this year's schedule in order to show separately the acreages under spring-sown and winter-sown wheat (Questions 1 and 2), the numbers of mares and geldings comprised under Questions 45 (horses used for agricultural purposes) and 46 (unbroken horses), and the numbers of sheep under and over one year old (Questions 71 to 78). Occupiers are also asked to state how much of the land forming the holding is owned by them (Question 44), in regard to which question—in common with all questions in the Agricultural Return—it should be clearly understood that the information supplied is strictly confidential and has no connexion with taxation.

The attention of occupiers is drawn to the Supplementary question relating to land which they may have let temporarily for summer grazing. If particulars of all such land are furnished, as requested, the Crop Reporter will be able to ensure that the person who has taken the grazing (and who is responsible for making a Return in respect of it) is supplied with a Schedule.

An additional form is being sent to occupiers on this occasion asking for particulars of the number of horses suitable for ploughing and harvesting and of the number of ploughs and self-binders and reapers in usable condition. The Ministry hopes that *all* occupiers will complete and post this form without delay. If an occupier has no horses of the type named or no implements in the condition specified it is just as important that the Ministry should know, so that the present position relating to these requisites of arable cultivation in England and Wales may be fully ascertained. The

further particulars asked for in this form—the size of the holding and the grass area—are merely intended to facilitate the work of tabulating the results of this enquiry. It should be noted that this additional form should be posted direct to the Ministry at the address printed on the back, and should *not* be sent back to the Crop Reporter.

Any occupier of agricultural land exceeding an acre in extent in England and Wales who does not receive both a Schedule and a form relating to horses and ploughs, etc., by June 4 should write to the Ministry of Agriculture and Fisheries, 80, Leonard Street, London, E.C.2, or to the Welsh Department of the Ministry, 17, Eastgate, Aberystwyth.

Applications for the Oats and Barley Subsidy, 1938

The form of application for Oats and Barley Subsidy in respect of land under those crops on June 4, 1938, is being printed as an additional page to the annual statutory return required under the Agricultural Returns Act, 1925. Every occupier of agricultural land exceeding one acre in England and Wales should, therefore, receive a copy early in June. It is important that no entries should be made on this form of application unless the occupier has decided that it is in his interests to apply for the Oats and Barley Subsidy. Subsidy is payable on the basis of the acreage of oats or barley grown and harvested, even though none of the produce is subsequently sold. Wheat growers are reminded that, once an application for subsidy has been properly completed and accepted, no Wheat Deficiency Payments can be made by the Wheat Commission in respect of any wheat grown on the farm during the same year. In no circumstances should the form of application be detached from the Agricultural Return

Intending applicants for the subsidy should, before completing the form, read the Explanatory Memorandum attached to the usual Memorandum for Guidance issued to occupiers in connexion with the completion of the Agricultural Return. By carefully following the instructions given at the end of the Explanatory Memorandum, applicants will avoid the necessity of subsequent correspondence.

Under the provisions of the Agriculture Act, 1937, applications for subsidy must be made this year by the person in occupation of the land on June 4, 1938, unless there has been a change of occupancy in the earlier part of the year and the outgoing occupier is entitled to harvest the whole or any part

of the corn crops growing on the farm on June 4, 1938, or to receive payment therefor. Any outgoing occupier who, from this point of view, may be interested in the Oats and Barley Subsidy Scheme, and also any person in occupation of land on which oats or barley are growing on June 4, who does not receive a form, should write to the Secretary, Ministry of Agriculture and Fisheries, 80, Leonard Street, London, E.C.2.

The Regulations made under the Agriculture Act require that all applications for the Oats and Barley Subsidy must be sent to the Ministry's Crop Reporter for the district concerned not later than June 25, 1938, and the Minister is precluded from accepting any applications received after that date unless he is satisfied that there were good reasons for the delay. Any applicant who does not receive an acknowledgement of his form of application within twenty-one days of its dispatch to the Crop Reporter should communicate with the Secretary, Ministry of Agriculture and Fisheries, at the above address.

Destruction of Bracken

It is well known that during the last fifty years there has been a heavy increase in the area invaded by Bracken (*Pteridium aquilinum*). Various suggestions have been put forward to explain this increase, but, even so, the reasons are not entirely understood. It is all to the good that the Bracken question is receiving the close attention of both botanists and practical agriculturists, but there is more than ample room for intensive investigation, and trial of methods of control.

In a paper read before the Royal Society of Arts on May 18, Mr. W. K. Braid, M.A., B.Sc. (Professor of Botany at the West of Scotland College of Agriculture, Glasgow), dealt with most of the points relating to the present menace of Bracken. He observed that it had been estimated that there are probably 1½ million acres of Bracken in Scotland alone. "Unfortunately," said Professor Braid, "no accurate survey of its distribution in Britain has been made, but we know that there are many hundreds of acres where Bracken was unknown in the youth of some of our living countrymen, but where it is now the dominating plant, and the grazing value of this land has been totally destroyed or severely limited. This means that only half as many sheep, or less,

can now be maintained on the upland grazings as was possible even at the beginning of the century."

It is true that an accurate survey has not yet been made, but Professor R. G. Stapledon's work in Wales showed that there are 153,000 acres of Bracken-clad country in the Principality, and his estimate led him to a figure of "something over $1\frac{1}{2}$ million acres of Bracken-clad country in the uplands of Great Britain." He has expressed the view (*The Hill Lands of Britain*, 1937) that "At the very lowest one-third of this acreage is on potentially excellent grazing land, much of it on potentially arable land, and a great deal of it on land that has in fact been under the plough in the past."

This is sufficient indication of the great area occupied by Bracken, which is also a burning subject in many parts of the Empire and in other countries, for this pest is substantially distributed throughout the world. Where Bracken occurs at its worst, in "close formation," it suppresses grass and heather—which in Scotland and some other areas is of such great value for both sheep and grouse—and the productive value of the land is lost, while direct loss of sheep may be due to the hiding of "struck" animals that seek its shelter and shade, and cause shepherds much trouble. Other points adverse to Bracken could be mentioned, but cannot be discussed in a short note.

It is commonly believed that the sheep boom last century led to wide changes in farming, fewer cattle being kept and the plough becoming less active in the uplands, while the migration and eviction of crofters gave rise to the saying that Bracken is the "heir to the crofter." In the discussion of Professor Braid's paper, indeed, one speaker observed that these facts seemed to imply that the farmers and landlords equally neglected their job in regard to the control of the pest and then the State was asked to provide a remedy. At the present time official grants are made in Scotland to enable farmers to buy Bracken-cutting machines, and in England and Wales the Ministry of Agriculture makes grants to local authorities for the provision of such machinery for demonstration purposes.

As regards eradication, it is said that the cost must be very low, because much of the infested land is only worth a rental of about 3*s*. per acre. If the land were clear of Bracken, however, it would be worth much more, for, as Stapledon

suggests, much of it was formerly under the plough and might be so again. While single cuttings may well be done at a little over 1s. 6*d*. per acre, such treatment must be repeated to effect control.

Professor Braid gave some account of no fewer than eleven cutting and crushing machines, and also dealt with the question of spraying Bracken with solutions of sulphuric acid and sodium chlorate, neither of which has yet proved satisfactory, either because of high cost or lack of successful control—or both. During the discussion considerable emphasis was laid upon the lime factor, and instances of reduction following applications of chalk were mentioned. It was also felt that bruising caused more "bleeding" and exhaustion than cutting, and led to the entry of disease. Some speakers expressed the view that it is very desirable to explore the uses of Bracken—e.g., for bedding, thatching, manufactures, as a source of potash, as a food for pigs, etc.

Hops: Report of Reorganization Commission for England

The Reorganization Commission for Hops, appointed by the Minister of Agriculture and Fisheries on February 25 of this year, issued its Report* on May 4 as No. 46 of the series of Orange Books on agricultural marketing issued by the Ministry.

The Commission, which consisted of Mr. A. W. Cockburn, K.C. (Chairman), together with Mr. A. F. Forbes, Mr. C. J. T. B. Grylls, C.B., C.B.E., Mr. T. W. Haward and Mr. R. D. Peck, were required to review the operation of the provisions of the Hops Marketing Scheme relative to quotas for the sale of hops which were incorporated in the Scheme in 1934 for a period of five years ending in July, 1939, and to consider whether the provision should be retained in the Scheme after that date with or without modifications.

The Commission point out that, owing to the peculiar characteristics of the hops industry, supply and demand are not easily brought into correspondence under free market conditions; and they conclude that planned production and marketing are essential to the welfare of the industry.

After reviewing the operation of the quota provisions since

* Hops: Report of Reorganization Commission for England. Published by His Majesty's Stationery Office as Economic Series No. 46. Price 1s. 0*d*.; 1s. 1*d*. post free.

1934, the Commission come to the conclusion that growers have been given a measure of security and confidence they did not previously enjoy, and that an adequate supply of home-grown hops of good quality has been forthcoming. They explain that the consumers—the brewers—have no objections in principle to the quota provisions, the smooth working and just administration of which are further ensured both by the voluntary Agreement between the Hops Marketing Board and the Brewers' Society, which has been in operation since 1934, and under which the price of hops is freely negotiated between the parties concerned, and by the existence of a Permanent Joint Committee consisting of representatives of hop growers and brewers and of three impartial members.

The Commission accordingly recommend that the quota provisions, in general, should be continued for a period of seven years from July, 1939; while a further Agreement should be negotiated between the Hops Marketing Board and the Brewers' Society, and the Permanent Joint Committee or some similarly constituted body should continue to function. It is also recommended that a further inquiry into the quota provisions should be held in 1944.

The Commission conclude that, on the renewal of the quota provisions, certain modifications should be made, relating in particular to the transfer of existing quotas and the issue of new quotas.

Progress of the Land Fertility Scheme

The number of applications for contribution under the Land Fertility Scheme received from occupiers of agricultural land in the United Kingdom now exceeds 166,000. The quantities of lime and basic slag in respect of which these applications have been made are approximately 1,021,000 tons of lime and 359,000 tons of basic slag.

THE DRYING OF HAY IN SWATH AND WINDROW

W. H. CASHMORE, B.A., N.D.A.,

AND

H. J. DENHAM, M.A., D.Sc.

Recent developments in haymaking have been directed rather to the reduction of costs than to the improvement of the quality of the crop. Modern equipment necessitates a larger outlay of capital, which must be covered by an increase in production. This increase, however, tends to prolong the haymaking season, and the risks of losses from unfavourable weather are enhanced.

Hay made by modern machinery, even under favourable conditions, is often inferior to that made by the older methods. The new procedure is to mow the crop and leave it in the swath for several days, with little or no swath-turning or tedding, until it is dry practically right through, when it is raked together and stacked. As a result, the top layer of the sward becomes over-dried and leached, resulting in a product of greatly reduced feeding value.

One of the chief advantages of baling hay in the field is that the hay can be picked up at an earlier stage than is possible for stacking, thus reducing losses in feeding value. But great variations in moisture content are to be found in different parts of the sward, and as material of 40 per cent. moisture and over causes mould in the bale, it is essential that the drying in the field should be even.

During the 1934 and 1935 seasons a series of experiments was carried out to investigate the rate of drying hay in the field under various atmospheric conditions and its relationship to field treatment. Self-recording instruments were used to obtain the atmospheric shade temperature and the percentage humidity at a point about 2 in. above ground level for each field of hay under observation. Two typical records, one for a fine day and one for a wet day, both made in June, 1935, are shown in Fig. 1. It will be seen that even in fine weather the air humidity was really only low for a few hours in the day.

Preliminary experiments showed that the rate of drying

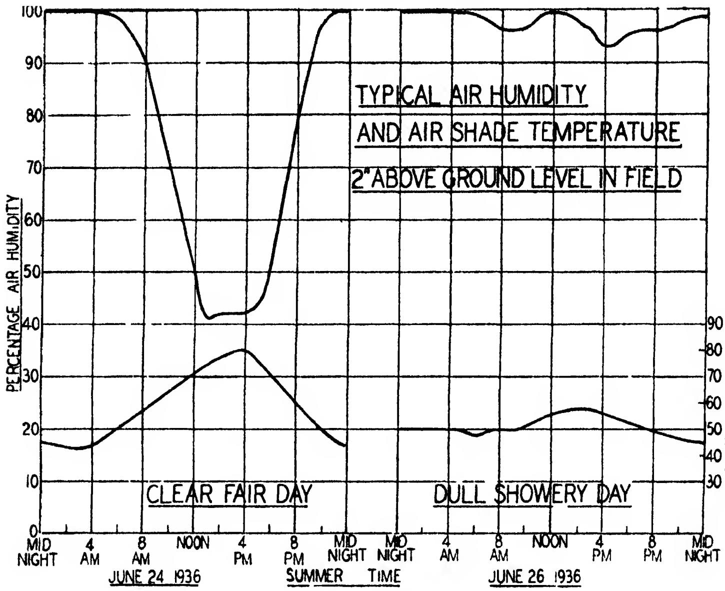


FIG 1

in the field depended upon the air humidity, the velocity of the wind, the condition of the swath, the moisture content of the material and the air temperature.

In the laboratory, various hays were subjected to controlled air humidities at several different temperatures. It was found that hay had an equilibrium moisture content for each percentage air humidity. This varied only slightly with temperature and the type of material. The hays higher in soluble constituents, i.e., grasses cut early in the season, had a slightly higher equilibrium range. Typical results are shown in Figs. 2 and 3. It was found that even with air only slightly below saturation point some drying will take place if the moisture content of the material is above the equilibrium moisture. In the field, the air falls below the dew points on most clear nights and there is a deposit of dew on the material. This gives a far greater rate of moisture absorption than those shown in Fig. 2 and, further, the rate, is more pronounced with increased surface.

In the field, the air humidity, wind velocity and air temperature cannot be controlled, but the conditions of the sward can be varied so as to obtain the best results from

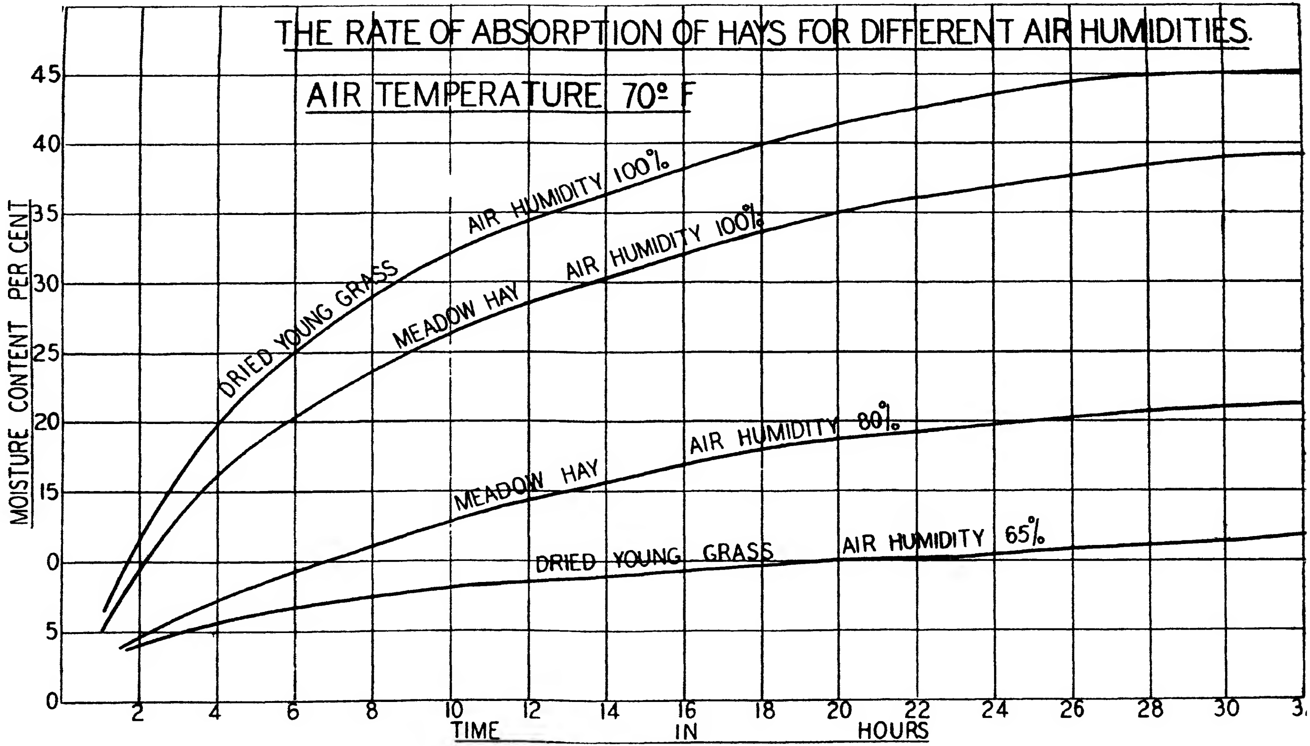

THE RATE OF ABSORPTION OF HAYS FOR DIFFERENT AIR HUMIDITIES.
AIR TEMPERATURE 70° F
DRIED YOUNG GRASS
AIR HUMIDITY 100%
MEADOW HAY
AIR HUMIDITY 100%
MEADOW HAY
AIR HUMIDITY 80%
DRIED YOUNG GRASS
AIR HUMIDITY 65%
MOISTURE CONTENT PER CENT
45
40
35
30
25
20
15
0
5
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
TIME IN HOURS

FIG 2

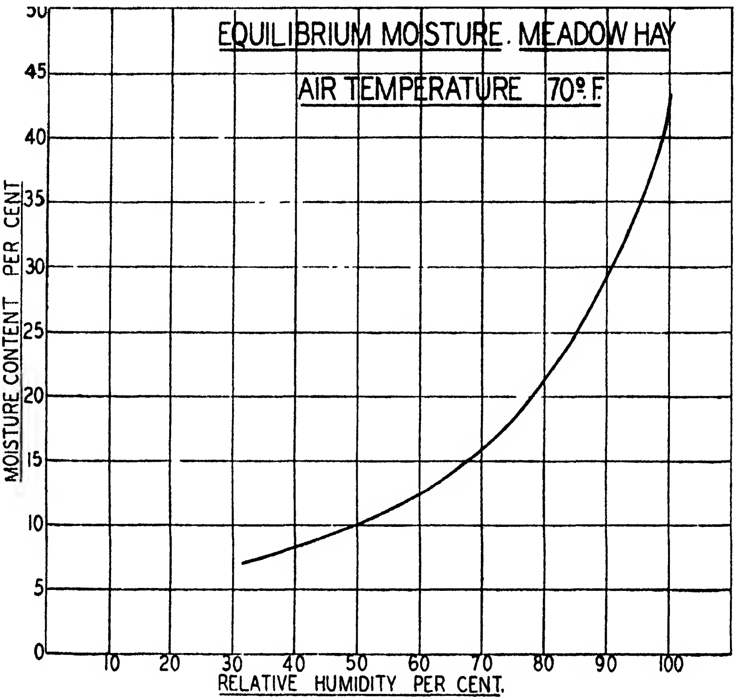


FIG 3

natural agencies, and, as a result of the preliminary investigation, the four following methods of field work were compared:—

(A) Grass cut and left in the swath until the average moisture content was low enough for safe stacking.

(B) Similar to A, except for tedding after 48 hours.

(C) Tedded immediately after cutting and again 24 hours after cutting

(D) Tedded immediately after cutting, and windrowed the same evening to reduce the surface exposed to dew Tedded again 24 hours after cutting.

It is obvious that if rain intervenes between the time of cutting and harvesting the differences are levelled up. The results shown in Table I and Fig. 4 are for the above four treatments in fine weather.

These results indicate that breaking up the swath immediately after cutting in fine weather conduces to an increased drying rate in the field, but, to take advantage of

TABLE I

CROP: MEADOW HAY, 21 CWT PER ACRE

Date	Time	Hours after Cutting	Moisture Content Percentage — Treatment A	B	C	D
June 23, 1935	10 a.m.	—	73·0	73·0	73·0	73·0
	11 „	1	66·5	Same as A	62·3	Same as C
	Noon	2	65·8		52·6	
	1 p.m.	3	63·5		48·7	
	2 „	4	60·0		42·4	
	3 „	5	56·4		37·0	
	4 „	6	55·0		37·0	
	5 „	7	56·0		36·1	
	6 „	8	55·3		35·5	
	7 „	9	54·0		34·0	
	8 „	10	53·5		34·7	
June 24, 1935	6 a.m.	20	59·0	Same as A	51·5	42·0
	7 „	21	—		—	—
	8 „	22	59·2		50·0	37·9
	9 „	23	56·0		48·9	38·0
	10 „	24	53·0		45·2	37·3
	11 „	25	—		—	—
	Noon	26	52·0		41·8	32·0
	1 p.m.	27	—		—	—
	2 „	28	50·0		34·0	28·1
	3 „	29	—		—	—
	4 „	30	43·1		33·3	24·5
	5 „	31	—		—	—
	6 „	32	44·2		29·0	24·1
	7 „	33	—		—	—
	8 „	34	43·0		23·9	22·0
June 25, 1935	6 a.m.	44	49·2	49·2	Finished	Finished
	7 „	45	—	—		
	8 „	46	48·8	48·8		
	9 „	47	—	—		
	10 „	48	—	—		
	11 „	49	44·6	42·7		
	Noon	50	41·7	38·0		
	1 p.m.	51	—	—		
	2 „	52	37·0	32·7		
	3 „	53	—	—		
	4 „	54	33·5	22·9		
	5 „	55	—	—		
	6 „	56	33·0	21·4		
	7 „	57	—	—		
	8 „	58	29·8	22·0		

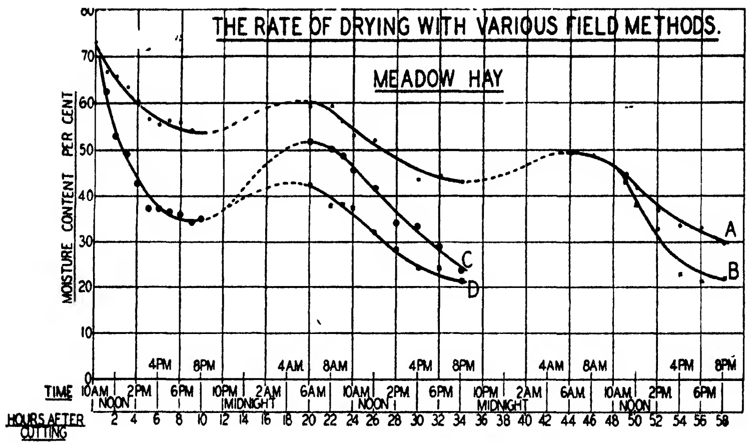


FIG 4

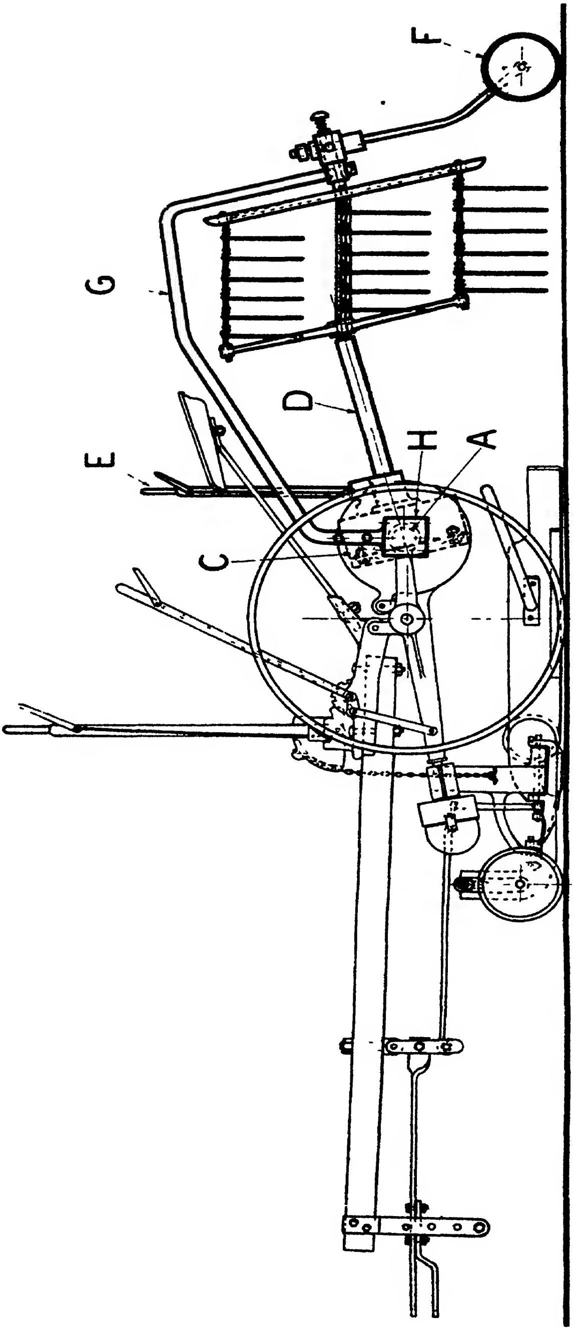
this, it is necessary to windrow the crop in the evening to prevent excessive damping up during the night. By this means it was possible to save 24 hours in the time required in the field, and at the same time produce material fairly free from wet patches, better in colour, and with a higher feeding value.

Tedders or side-delivery rakes work at about 1¾ acres per hour with one horse and a man or boy. The running cost does not exceed 9*d*. per acre, but, although the cost is not appreciable, they are seldom convenient. To overcome this difficulty a combine mower and swath breaker was built for the purpose of determining how far it would be possible to combine satisfactorily the two operations in one machine.

The machine shown in the diagram consists of a single swath turner unit of the tine type, combined with a standard 4 ft. 6 in. horse mower. The mower has a right hand cut, and the swath turner works in a clockwise direction, turning the swath away from the growing crop.

The swath-turning attachment is placed behind the main frame in a suitable position for turning the previously cut swath. This position was decided upon in preference to one immediately behind the knife, because it does not interfere with the raising of the cutter bar for transport and is more satisfactory for the drive to the swath turner mechanism.

The mower back shaft, **A**, which is directly behind the axle, is replaced by an extended shaft, **B**, supported by


F
G
E
D
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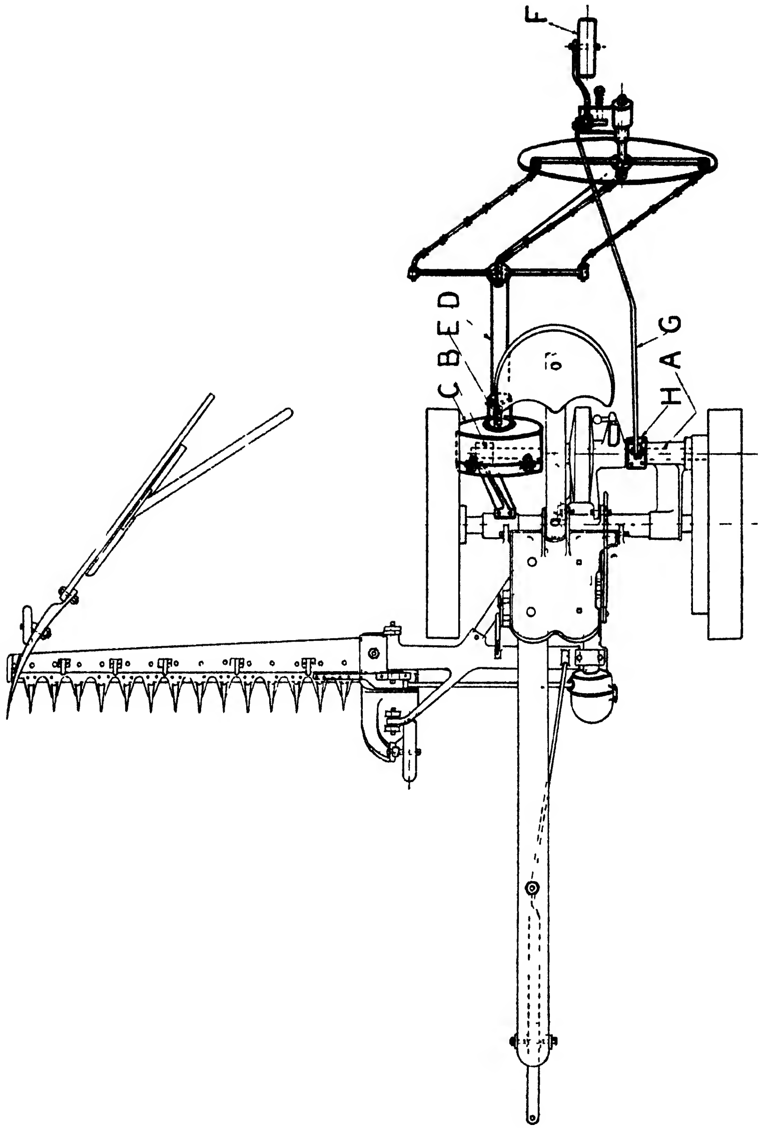
C


F
C B E D
H A G

additional roller bearings and fitted with a pair of bevel wheels and a thrust bearing enclosed in a casing, **C**, at a point to the right hand side of the seat. By this means the necessary drive is given to the tedder shaft, **D**, which is at right angles to the mower back shaft. The gearing is arranged to give a tedding speed of 20 per cent. above the normal. A hand-operated clutch controlled by lever, **E**, from the mower seat is placed between the bevel drive and the tedder shaft.

The tedder attachment is free to swing about the back shaft on suitable bearings. The rear end is supported by a wheel, **F**, which is adjustable in height in the usual way. A tie rod, **G**, attached to the rear bracket is bolted to a clamp, **H**, which is free to swing on the frame casing of the mower back shaft. Thus the tedder is free to swing about the mower back shaft and so enable the tedder tines to keep a constant distance from the ground on the flat or on ridge and furrow.

The machine can be used as a mower with the swath turner out of gear and lifted to clear the cut crop, and, if required, the tedder only can be worked with the cutting mechanism out of gear.

It will be seen from the diagram that the machine is, for convenience, fitted with a standard tractor drawbar in place of the 2-horse pole. The increase in draught due to the tedder is small and the total draught is well within the capacity of two horses. Control levers are operated from the mower seat, but there are no difficulties in the way of modifying these levers for control from the tractor driver's seat, as in standard practice.

The combined machine extends about 5 ft. 6 in. behind the mower axle, and, apart from the extra care necessary when starting a field, the machine performs in a similar way to a standard mower. As the swath turner drive is taken from the main mower shaft, the turning mechanism is free when the machine is reversed.

During 1936, field experiments were made with the combine mower swath breaker in place of a mower and a separate tedder. Because of the abnormally wet season, any hay-making was very difficult, but when field drying did take place the previous good results were confirmed and the combine mower swath breaker proved practically as efficient as separate tedding.

Conclusions. Sufficient attention is not paid to the care of the hay crop between mowing and collecting. It is possible to shorten the field time and to obtain a better product when the effect of different atmospheric conditions is understood and the treatment varied accordingly.

There is a tendency to-day to produce heavier hay crops by the use of fertilizers, and a method of haymaking that is satisfactory with light crops is useless with these heavier crops.

Whether or not a combine mower swath breaker is used, tedding immediately after mowing to break up the swath, and windrowing before evening to reduce the effect of dew, is advantageous.

It has been rightly argued that breaking up a swath is harmful if rain intervenes. On the other hand, by observing weather reports it should be possible in most seasons to mow with two fine days ahead. By hastening the process hay can be made dry enough to put into cocks in a very short time and so the method has its advantages even in a wet season.

PRODUCTION OF "CERTIFIED" STOCKS FOR PLANTING

POTATOES—STRAWBERRIES—BLACKCURRANTS

Schemes for the inspection in England and Wales of growing crops of potatoes intended for seed, of strawberry plants grown for runners and of blackcurrant bushes, will be continued by the Ministry this year on the lines followed in previous seasons. The object of the schemes is, broadly, to stimulate the production of and demand for supplies of "parent stocks" of a high degree of varietal purity and a reasonable standard of vigour. To this end the Ministry undertakes the issue of certificates to growers of crops attaining the necessary standards, and the publication, for the information of prospective purchasers, of registers containing particulars of the growers and crops in question. The following details of the working of the three schemes in recent years may be of interest:—

Seed Potatoes. A scheme was initiated in 1918 to promote the production of clean seed of varieties of potatoes approved as immune from Wart Disease suitable for planting in land contaminated with that disease. In 1923, this system of certification of approved immune varieties was recognized for the purposes of the new Wart Disease Order* made in that year, and which is still in force. The value of this scheme was so much appreciated by progressive potato growers that the Ministry was asked to consider its extension, and in response to this demand a voluntary scheme was instituted in 1924 for the certification of varieties, other than approved immunes, which attained similar standards of purity and health. The extent to which growers have availed themselves of these schemes during the last five years is shown in the table on the following page.

The standard of varietal purity stipulated as essential to qualification for a certificate is high, 0.5 per cent. only of rogues being permissible; nevertheless, in 1937, 4,723 acres

*** The Wart Disease of Potatoes Order of 1923 prohibits, *inter alia*, the planting in any land on which Wart Disease has occurred at any time, of any potatoes except approved immune varieties which were inspected whilst growing and certified as true to type and reasonably free from rogues.**

Year	Approved Immune Varieties			Other Varieties		
	Inspected (acres)	Certified (acres)	Certificates Issued	Inspected (acres)	Certified (acres)	Certificates Issued
1933 .	4,342	3,866	902	2,669	2,421	740
1934 ..	3,226	2,866	727	2,370	2,174	608
1935 ..	2,616	2,288	617	2,478	2,228	559
1936 ..	3,345	2,961	728	2,181	1,961	600
1937 ..	3,374	2,959	749	1,986	1,764	598

representing 88 per cent. of the crops entered for inspection reached that standard. In 1935 and 1936, the comparable percentages were 86 and 87 respectively.

A few well-known varieties account for the bulk of the area examined. Among the immune varieties, " Majestic " predominates, accounting in recent years for almost one half of the total acreage certified. Next in order of importance during last season were " Arran Banner " (396 acres), " Great Scot " (340 acres) and " Kerr's Pink " (269 acres). Three of the newer immune varieties, viz., " Doon Star," " Arran Pilot " and " Gladstone," though as yet represented by relatively small acreages, show an advance in popularity. " King Edward VII " is still by far the most commonly favoured amongst the other varieties, and the 1,018 acres of this variety qualifying for certificates last season represented 58 per cent. of the total average certified under the voluntary scheme. Other prominent varieties in this section were " Eclipse " (175 acres) " Ninetyfold " (166 acres) " Sharpe's Express " (124 acres) and " King Edward VII " (Red Type) (109 acres).

Strawberry Plants. Under this scheme, stocks of strawberry plants, from which it is proposed to take runners for sale, are inspected whilst growing with a view to their certification if found to be true to type (i.e., of varietal purity) and reasonably healthy. It is not possible to guarantee that stocks are free from disease; a certificate is not granted, however, in respect of any stock that is lacking in vigour or is obviously unhealthy.

For practical reasons the scheme is limited to lots of not less than 500 plants of any one variety and to a total crop of not less than 2,000 plants at each separate farm or nursery.

For similar reasons inspection is restricted to the following varieties:—

Bedford Champion
Deutsch Evern.
Huxley (Brenda Gautrey)
Jucunda (Amazone).
Madame Kooi (Madame Moutot, Princess Juliana)
Madame Lefebvre
Oberschlesien
Pillnitz.
Royal Sovereign (Laxton's King, George V).
Sir Joseph Paxton.
Tardive de Leopold
The Duke.
The Laxton.
Western Queen

In the light of the experience gained in previous seasons, the standard of varietal purity was raised in 1936 from 99 per cent. to 99.5 per cent., at which level it has been and will again this season be maintained; thus certificates are not issued for stocks containing more than 0.5 per cent. of rogues. Applications were received from 88 growers during 1937 for the inspection of 187 acres of plants. This compares with 116 applications covering 253 acres in the preceding year. As in earlier years, most of the applications came from the Wisbech area of the Isle of Ely, Lincolnshire (Holland) and Norfolk, growers in these counties being responsible for entering 120 acres or almost two-thirds of the total area submitted, Hampshire (27 acres) and Kent (11 acres) came next in importance. The number of stocks and the acreage of each variety entered for inspection during the past four years are set out below:—

Variety	1934		1935		1936		1937	
	No of Stocks	Acreage	No of Stocks	Acreage	No of Stocks	Acreage	No of Stocks	Acreage
Bedford Champion	10	3·3	12	3·4	7	2·4	6	1·8
Deutsch Evern	5	3·6	6	2·1	4	1·3	3	2·2
Huxley (Brenda Gautrey)	—	—	50	30·8	28	25·0	22	11·4
Jucunda	1	0·1	1	0·1	1	2·5	2	2·6
Leader ..	1	0·1	1	0·1	1	0·1	-	—
Madame Kooi .	12	4·3	10	3·8	7	2·1	1	0·1
Madame Lefebvre	38	19·3	47	23·0	32	21·8	22	12·6
Oberschlesien ..	92	99·4	72	67·1	66	60·8	42	48·6
Pillnitz . ..	-	—	15	8·3	18	7·6	6	2·0
Royal Sovereign	103	159·6	121	147·4	86	100·3	60	88·1
Sir J Paxton .	24	24·4	17	12·2	16	8·9	9	3·4
Stirling Castle	2	0·6	1	0·1	1	0·1	—	—
Tardive de Leopold	30	22·8	32	18·4	24	13·9	12	3·4
The Duke ..	9	4·2	5	4·3	6	3·9	4	3·5
The Laxton .	2	0·6	2	0·8	2	0·2	2	1·3
Western Queen ..	—	—	—	—	7	1·9	12	6·0
	329	342·3	392	321·9	306	252·8	203	187·0

It will be seen that " Royal Sovereign " (88 acres) and " Oberschlesien " (49 acres) accounted jointly for approximately three-quarters of the area inspected in 1937. "Huxley" and "Madame Lefebvre" occupied half the remaining acreage inspected. No less than 178 acres, or approximately 95 per cent. of the total area inspected qualified for certification, as compared with an acreage of 253 and a percentage of 82 in 1936. This unusually low percentage was due to the large number of stocks that were found in that year to be unhealthy or lacking in vigour; in the Wisbech district in particular several stocks, especially those of the variety " Huxley," failed to qualify for certification, although in previous seasons they had been found healthy.

Blackcurrant Bushes. Under this scheme certificates are issued in respect of blackcurrant bushes that at the time of inspection are two years of age and over, and found to be true to type (attaining a standard of purity of not less than 99 per cent.), apparently free from Reversion, and vigorous. Although it is not possible to guarantee that the bushes to which a certificate relates are free from Reversion or from " Big-Bud," a certificate is not issued in respect of stocks found to contain reverted or mite-infested bushes to the extent of more than 1 per cent.; certificates under this scheme are also refused in respect of stocks submitted if there is evidence that other blackcurrant bushes on the holding are substantially attacked by either of these ailments.

In 1937, applications were received from 34 growers for the inspection of about 566,000 bushes. In the 3 preceding years the number of growers ranged between 22 and 30 and covered between 400,000 and 418,000 bushes.

Bushes attaining the requisite standard of purity, health and vigour are normally classified for certification purposes into four main group types adopted by the East Malling Research Station, namely, French Black, Boskoop Giant, Edina and Baldwin, any varietal names given by the applicants being inserted in brackets; some varieties have not yet been classified in any of these groups, and for these the stocks are certified true to variety. The following table shows the number of bushes inspected and certified during the past four seasons:—

Production of "Certified" Stocks

	1934		1935		1936		1937	
	In-spected	Certified	In-spected	Certified	In-spected	Certified	In-spected	Certified
French Black	66,720	50,320	56,480	35,755	67,000	63,600	109,910	99,865
Boskoop Giant .	44,530	33,230	51,127	22,368	66,770	64,770	65,917	63,295
Edina ..	24,130	21,580	17,577	16,027	40,015	40,015	35,736	34,213
Baldwin ..	181,710	148,910	208,147	183,040	195,545	185,595	278,804	270,864
Unclassified Varieties ..	90,448	64,298	67,203	46,140	48,225	40,025	75,724	73,440
	407,538	318,338	400,534	303,330	417,555	394,005	566,091	541,677

Certificates were granted for about 96 per cent. of the bushes inspected in 1937 as compared with 94 per cent. in 1936 and 76 per cent. in 1935.

Some 25,000 bushes failed to qualify for certification, and these were rejected for the following reasons:—

General lack of vigour (11,000); substantial attack by Reversion (7,000); rogues exceeding 1 per cent. (5,000); unrecognizable (1,500); small bushy plants exceeding 5 per cent. (500).

THE BEET EELWORM

(*Heterodera schachtii*, Schmidt.)

F. R. Petherbridge, M.A.,
J. H. Stapley, B.Sc., A.R.C.S.
and
I. Thomas, Ph.D.,
School of Agriculture, Cambridge

The repeated cropping of land with sugar-beet often leads to a condition known as " beet sickness." This condition is caused by the attacks of the eelworm, *Heterodera schachtii*, Schm.

The reduction in yield brought about by this pest was so great in Germany that in 1876, twenty-four sugar factories were closed down. The beet eelworm is a serious pest in several other European countries and also attacks large areas of sugar-beet in the United States of America. In November, 1934,[1]* it was recorded attacking sugar-beet in England for the first time.

Life-history. Sugar-beet eelworms lie dormant in the soil throughout the winter as eggs contained in brown lemon-shaped cysts, the largest of which are only 1/16 in. long. These cysts are the dead outer walls of the bodies of swollen female eelworms. A large cyst may contain as many as 650 eggs. The eggs hatch into young eelworms, which begin to escape from the cysts into the soil in the spring. The eelworms do not all escape in the first season and eggs may live for several years within the cysts. One observer claims that after six years most of the cysts are empty and only a very few live eggs remain.[2] The young eelworms make their way into rootlets, where they feed on the cells. Later, the females become swollen and lemon-shaped and at this stage they burst out of the rootlet, only the head and neck remaining embedded. The males likewise leave the rootlets and wander in the soil in order to find and fertilize the females. After fertilization, the females become full of eggs and then die, but their dead bodies remain intact, forming protective sacks for

* For references, see p. 236.

the eggs. The bodies are now known as "cysts." These gradually turn brown and drop off the rootlets into the soil. Most of these are present in the top soil, but in America and on the Continent cysts have been found at a depth of 30 in. Those which contain living eggs or young eelworms are called "viable cysts"; others are empty and are those from which all the young eelworms have escaped. There is probably only one generation in each year.

The beet eelworm belongs to the same species as the potato root eelworm, which causes "potato sickness," but it is a different strain and does not attack potatoes, neither does the potato root eelworm attack sugar-beet. Two other strains attack cereals and leguminous crops respectively, but neither of these strains attacks sugar-beet.

The cysts of the beet strain are similar in appearance to those of the oat strain (which attacks cereals). These cysts are lemon-shaped and the writers use the term "beet strain type" to include cysts of both the beet and cereal strains. The potato strain cysts are distinguishable from these by their spherical appearance. The cysts of the pea strain (which attacks leguminous crops) are intermediate in shape, but difficult to distinguish from the beet strain in a mixed sample.

Nature of Damage. The first sign of bad eelworm attack is seen as a small patch or patches in the crop, where the plants are stunted and the foliage has an unhealthy appearance (see Fig. 1). When the attack gets worse, these patches become much larger (see Fig. 2) and the beet stunted and almost valueless. Fields that will no longer grow profitable crops of sugar-beet because of the loss so caused are described as being "beet sick," and the condition is known as "beet sickness."

The outer leaves of badly attacked plants wilt in the sunshine, later on turn yellow, and finally die. The heart leaves may remain green, but are undersized and an abnormal number of them is formed; in very severe attacks even these may die. Such plants are easily pulled from the soil, when the characteristic root symptoms may be seen. The tap root is small and often short, and there is an excessive development of lateral roots known as "hunger roots" (see Fig. 3); most of these rootlets are dead and a careful examination will reveal the presence of small lemon-shaped cysts—either white, yellow or brown in colour (see Figs. 3 and 4).

Attacked beet are not usually killed, but remain small and possess a low sugar content.

How the Eelworms are Spread. Experiments have shown that young eelworms can travel up to ten yards in the soil. Once a field is infected, therefore, the eelworms can spread by themselves to a certain extent, but, in practice, their spread is mainly brought about by artificial means. When soil from an infected field is taken to another field the latter also becomes infected with the eelworm. This pest can thus be spread from field to field by means of carts, tractors and other farm implements, workers' boots, or the legs of horses, sheep or cattle. Infection can also take place when infected beet, in the process of transport, fall from carts or lorries on to other fields, or if the dirt from such carts and lorries is returned to fresh land. It is probable that " dust storms," such as that which occurred in the Fens in 1935, will carry cysts from infected fields to neighbouring fields.

As the cysts float readily in water, there is danger of their being carried in irrigation water or floods. Heavy rains often wash soil to lower levels.

Viable cysts have been found in soil that has fallen from the beet at several factories and also in the settling ponds. If this soil or the sediment is returned to the land, the latter will become infected, as has happened in many instances on the Continent.

At some factories the beet are washed from the lorries by powerful jets of water and this water is used over and over again. At one factory the writers found cysts in this water. There is therefore a definite risk that some of these cysts will find their way to lorries bringing beet from eelworm-free farms and eventually to the fields of these farms.

American writers suggest that the sugar-beet eelworm was introduced into America by means of cysts present in small clods of dirt mixed with imported beet seed.

Dr. Triffitt, 1935,[4] made a careful examination of small particles of soil obtained from sugar-beet seed imported from Germany and found one cyst of the beet strain type containing empty egg membranes and a single embryonated egg.

Early in 1935 the rubbish from several sugar-beet seed bags, consisting of dirt and fragments of beet seed, was carefully examined, but no eelworms were found. In 1936 the

Fig. 1. First signs of Beet sickness: patches of Small Beet

Fig. 2. Later stage of Beet sickness

FIG 3—Sugar-beet attacked by Beet Eelworm Showing hunger roots with white lemon shaped Cysts and a short Tap Root

FIG 4 Lateral Roots of Sugar beet bearing white lemon shaped Cysts of the Beet Eelworm

writers sought the co-operation of the Bury St. Edmunds Beet Sugar Factory and they arranged to pick out the small lumps of soil from a large quantity of sugar-beet seed. The lumps from the different growers were kept separate. By this means about 100 grms. of soil was obtained. In the soil from one consignment of seed of German origin, three cysts indistinguishable from those of the sugar-beet strain were found. In two of these cysts, eggs with slightly shrivelled eelworms were found, but none of them was alive. Single empty cysts were found in each of the two other consignments of German seed. In one of the consignments of English seed, six cysts of the potato strain of *H. schachtii* were found; five of these contained viable eggs. This shows that sugar-beet seed is capable of carrying eelworm cysts, and suggests that the beet eelworm may have found its way to this country originally by means of cysts in the dirt present in consignments of sugar-beet or mangold seed.

There is a possibility that the soils from infected fields on the Continent have been introduced into our fields in other ways. Sugar-beet stecklings grown in infected fields would provide a ready means of introducing cysts. The Ministry of Agriculture has accordingly issued an order* prohibiting the importation of sugar-beet and mangold plants except under special licence.

Host Plants. Workers in U.S.A. and on the Continent have found that many crop plants and weeds are attacked by the sugar-beet eelworm. The writers have found most of these host plants attacked by beet eelworm in this country, as shown in the following list:—

HOST PLANTS OF THE SUGAR-BEET STRAIN OF *Heterodera schachtii* FOUND IN ENGLAND IN 1935 AND 1936

CROP PLANTS

Sugar-beet	Brussels Sprouts
Beet Root	Broccoli
Spinach	Cauliflower
Swede	Kale
Turnip	Cress
Cabbage	Radish

* The Importation of Plants (Amendment) Order of 1935, dated December 10, 1935. S.R. & O. 1935, No. 1225.

WEEDS

Chenopodiaceæ

White Goosefoot or Fat Hen (*Chenopodium album*)
Sowbane (*Chenopodium hybridum*)
Common Orache (*Atriplex hastata*)

Cruciferæ

Charlock (*Brassica sinapis*)
Hedge Mustard (*Sisymbrium officinale*)
Shepherd's Purse (*Capsella bursa-pastoris*)
Wild Radish (*Raphanus raphanistrum*)

Polygonaceæ

Broad Dock (*Rumex obtusifolius*)
Knotweed (*Polygonum aviculare*)

Solanaceæ

Black Nightshade (*Solanum nigrum*)

Crop plants not attacked by the sugar-beet strain of *Heterodera schachtii* when growing in infested land in 1935, 1936 or 1937 :

Wheat	Potatoes
Oats	Peas
Barley	Chicory

Staniland and Walton, in 1928, found *H. schachtii* attacking mangolds, cauliflowers and a variety of weeds in Gloucestershire. Dr. Triffitt, 1929,[5] showed that this strain readily attacked sugar-beet and most of the other crop hosts given above.

The writers have found far more cysts on the roots of cultivated plants than on any of the weed hosts; indeed, on some of the latter the number of cysts was very small. It is probable that many of the weeds would not bring about a marked increase in eelworm population unless present in very large numbers.

Distribution in England. In this country the first record of attack on sugar-beet by this pest was made in 1934 in a field showing symptoms of beet-sickness on a farm in the Isle of Ely. Beet eelworms were also found in several fields near by, but were not sufficiently numerous to cause an obvious loss of crop. Since then beet-sickness due to eelworm has been found on several other fields on this farm and also on nine other farms or smallholdings in the neighbourhood. The previous cropping of these fields shews how this large eelworm population has been built up. It was a common practice, before sugar-beet was grown in this area,

to grow mangolds, frequently for sale off the farm. In fields conveniently situated for transport mangolds were often grown for many years in succession.

The rotation of the field on which beet-sickness was first found was as follows:—

1921	Mangolds	1928	Wheat
1922	Mangolds	1929	Mangolds
1923	Mangolds	1930	Mangolds
1924	Mangolds	1931	Beet
1925	Wheat	1932 . ..	Potatoes
1926	Oats	1933 ..	Beet
1927	Mangolds	1934 .. .	Beet

The neighbouring field grew a very poor crop of mangolds in 1928 and was almost certainly suffering from beet-sickness as eelworms were found there in 1934, although no beet or mangolds were grown after 1928. This field had carried seven crops of mangolds in eight years. There seems little doubt that the eelworm population in this district was built up by frequently cropping with mangolds.

Beet-sickness has also been found on three smallholdings on fen soil in Methwold Fen near Southery. Two other holdings are infected with eelworm, but not sufficiently to cause sickness. These holdings have been cropped with beet in alternate years or more frequently. As there are several holdings in one field, the eelworms have ample opportunity to pass from one holding to its neighbour. Close by is a small field in which mangolds were badly attacked by eelworm. This field has grown mangolds continuously for at least ten years.

Beet-sickness is present on three farms near Hilgay, Norfolk, and the eelworm has been found on eight other holdings. Beet-sickness was found in one smallholding near Downham Market, Norfolk, and nearby another holding was found to be infected. Beet-sickness was also found on one field near Norwich and nearby, beet eelworms were found on kale. The common rotation in these instances is beet every other year. It is also present near East Harling, Norfolk, in a light land field that grew beet for nine or ten years running. The beet eelworm has also been found in a field near Feltwell, and in a field next the Beet Sugar Factory at Wissington, part of which has been used for dumping sugar-beet.

In 1937 cysts were found on old beetroot plants from the previous year's crop in a field near Langford, Bedfordshire,

and later, on Brussels sprouts plants grown on the same land. More recently, cysts have been found on the roots of young cabbage plants taken from a seedbed near Potton, Bedfordshire.

Mr. A. Roebuck, Advisory Entomologist to the Midland Agricultural College, reports that in two fields in Lincolnshire, in 1936, swedes were badly attacked by beet eelworm, one field near Barton and one in the Isle of Axholme. In both fields there were patches of small swedes with masses of lateral roots forming a beard and presenting an appearance similar to sugar-beet attacked by eelworm. In the field in the Isle of Axholme sugar-beet, mangolds and swedes were grown in strips. The sugar-beet followed red beet and celery, and the swedes and mangolds followed sugar-beet. Although the sugar-beet and mangolds had a large number of eelworm cysts on their roots, they did not suffer nearly so badly as did the swedes. For eleven years this farmer had grown mainly red beet and celery, not necessarily alternately, a practice which his predecessor had also followed. Sugar-beet was grown on this field for the first time in 1935. As celery is not attacked, the eelworm population was presumably built up by red beet. In the field near Barton the rotation was—1933, Barley; 1934, Kale; 1935, Barley; 1936, Swedes. Mr. Roebuck also reports severe damage to swedes in a garden in Lindsey.

In 1936, Mr. W. E. H. Hodson, Advisory Entomologist for the Southern Province, reported " Turnips failing in large patches at Puddleton, Dorset, due to attacks of eelworm." The cropping of the infected field was—Turnips; Barley; Trifolium and Turnips; Oats; Turnips. The eelworm population on this field was apparently built up by turnips.

The number of fields infected with beet eelworm is probably small, and it is important at this stage of the growing of sugar-beet in this country that steps should be taken to prevent this pest from spreading and particularly to prevent other fields becoming infected from fields already infected.

Cysts Content of Soils. Some idea of the enormous number of eelworms present in sick soils may be gathered from the fact that the writers have found over 100,000 eggs per lb. of soil (over 200 eggs per grm.).

Soil samples were taken in the winters of successive years from infected fields, and the number of cysts present

determined. These figures show that the eelworm population varies with the cropping, as shown in Table I.

TABLE I—CYST AND EGG CONTENT OF SOIL SAMPLES FROM FIELDS INFESTED WITH *Heterodera schachtii* (SUGAR-BEET STRAIN)

FIELD	1	2	3	4	5	6	7	8
Crop in 1934	*Chicory*	*Wheat*	*Wheat*	*Wheat*	*Wheat*	*Sugar-beet*	*Sugar-beet*	*Mangolds*
Cysts per 10 grm Soil, Feb 1935	6·5*	1·6	4·2	—	33·0	—	12·7	—
Viable Cysts per 10 grm ..	1 2*	0 4	0·4	—	8·8	—	most	—
Eggs per grm ..	5·8*	5·7	17·1	—	94·1	—	261·0	—
Crop in 1935	*Sugar-beet*	*Sugar-beet*	*Sugar-beet*	*Potatoes*	*Chicory*	*Wheat*	*Wheat*	*Wheat*
Cysts per 10 grm Soil, Feb 1936	27·6	4 2	10·4	0·1	32 5	3 9	22·0	25·2
Viable Cysts per 10 grm ..	11·8	2·5	6·5	0·0	2·0	1·5	15·6	11·2
Eggs per grm ..	191 8	48·4	111·0	0·0	10·0	15·2	139·8	154·4
Crop in 1936	*Potatoes*	*Wheat*	*Wheat*	*Sugar-beet*	*Wheat*	*Potatoes*	*Potatoes*	*Potatoes*
Cysts per 10 grm Soil, Feb 1937	20·1	3·0	11·5	0·9	18·0	2·1	13·5	15·1
Viable Cysts per 10 grm. ..	6·9	1·5	5·0	0·4	0·2	0·7	4·8	5·4
Eggs per grm ..	98·2	18·7	90·7	4·7	0·3	4·6	55·2	64·4

* Sample taken from small portion of field

Field 1 had not grown beet or mangolds since 1928, when the crop was poor and the field was almost certainly suffering from beet-sickness. Since that date the crops have been—1929, Cress seed; 1930, Mustard; 1931, Mustard; 1932, Potatoes; 1933, Wheat; 1934, Chicory; 1935, Beet. In February, 1935, the number of eggs per grm. had been reduced to 5.8. The growing of sugar-beet in 1935 increased the number of eggs considerably and small patches showing beet-sickness were present in this field.

Field 2 shows a similar increase after the sugar-beet crop,

but the number of viable cysts present before the beet crop in Field 1 was three times the number in Field 2. Beet-sick patches were present in the field.

Field 3 is again similar. One large beet-sick patch was present in the 1935 crop.

Field 4, when first sampled after the 1935 crop, was almost free from eelworm, only one empty cyst per 100 grm. of soil being detected by the method of sampling. A few eggs were most probably present at the time, since after the beet crop of 1936 a few cysts containing eggs were found.

In Field 5, where beet was last taken in 1931, a big reduction in the number of eggs has apparently followed the growing of chicory.

Fields 6, 7 and 8 show that the eelworm population decreases in the absence of susceptible crops.

From the above figures it is evident that, when the eelworm population is widely distributed over a field, there is a marked increase in numbers when sugar-beet is grown; also, that in fields where a large eelworm population is present it takes several years of non-susceptible crops to reduce the number sufficiently to grow a satisfactory crop of sugar-beet.

It is suggested that an estimation of the viable cyst content of a soil sample is not such a reliable guide to the state of the infestation as is the determination of the number of viable eggs.

A continental worker, Rensch, 1923[3] has shown by the addition of leachings from pots of sand, in which sugar-beet seedlings were growing, to water containing sugar-beet eelworm cysts, that the young eelworms hatched in far greater numbers than from cysts in water only. This suggests that far more larvae hatch when a sugar-beet crop is grown than with an immune crop.

Passage through Animals. A continental worker, Chatin,[6] fed sheep with badly infected sugar-beets for some weeks, but could find no living larvae of the beet eelworm in their droppings. Although the eelworm may not be present in material passing through animals, it is probable that they would find their way by other means into the farmyard manure when infected roots are fed to stock in the yards. Manure so made would readily infect fresh land.

Control Measures. Most of the investigations on the control of this pest have been carried out in Germany, where

the effect of an enormous number of chemical substances on eelworm-infected soils has been tested. None of these substances is cheap enough for use on agricultural land. Trap cropping has been extensively tested, but this method is no longer used owing to the difficulties attending it.

Continental observers agree that the most important method of reducing this pest is by means of suitable rotations, and that this eelworm has much decreased since sugar-beet has been grown less frequently.

As a result of continental experiences and observations made in this country, the writers make the following recommendations:—

(1) In fields or small holdings where beet-sickness has occurred or where the egg count is high, sugar-beet, mangolds, beetroot, spinach, turnips and swedes, and it at all possible other cruciferous crops, should be omitted from the rotation **for at least 5 years.** Before sugar-beet is grown again, the egg count of the soil should be determined and expert opinion obtained.

(2) In fields or small holdings where beet eelworms are present and where the egg count is low, the crops mentioned in (1) should be omitted from the rotation *for 3 years.*

(3) In fields or small holdings where no beet eelworms are present, sugar-beet may be grown every third year provided that in the intervening years mangolds, spinach, turnips, swedes, and, if at all possible, other cruciferous crops, are not grown.

(4) Special care should be taken to prevent the spread of this pest when soil from an infected field is carried to clean fields. Laying an infected field down to grass or lucerne would minimize the chances of the spread of the eelworm. The practice of alternate husbandry, where the grass is down for four years and then under the plough for four years, might be suitable on some farms.

Smallholders are reminded that if they borrow implements that have been used on infected land they will probably infect their own land unless they take special precautions to clean the implements. Also, if they walk over infected land they are liable to carry the eelworms in soil on their boots. The only safe method of removing eelworm cysts from Wellington boots is to wash them. The

writers have found cysts on boots after scraping them well with a trowel.

(5) Infected crops should not be carted over land free from this eelworm, except permanent grass land. A small-holding in Methwold Fen was probably infected in this way as the eelworm was found only on the headland over which infected beet had been carted.

(6) Special care should be taken when carting infected beet on roads common to several fields to see that roots do not fall on to other fields. (The writers once found a highly infected beet on the edge of an otherwise clean field.)

(7) Plants such as cabbage plants or flowers raised on infected land should not be planted on clean land.

(8) Manure made in yards where infected mangolds or swedes are fed to the stock should not be applied to arable land that is free from beet eelworm.

(9) Special care should be taken at the factories in dealing with infected crops.

(10) Dirt falling from sugar-beet at the factory and washings from these beet, should not be spread on arable land.

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ON THE USE OF COMMON SALT AS A FERTILIZER

IRESON W. SELMAN, B.Sc., Ph.D.,
Rothamsted Experimental Station

Historical. The value of salt to agriculture was probably first recognized by the ancient Persians and Chinese, who are reported to have used it, especially for date trees. In large quantities it was certainly known to exert a very harmful effect on vegetation; thus the ancient Jews strewed salt on their enemies' fields to render them barren and infertile. About the time of Christ, salt was used as a manure in Italy, and Pliny (23-79 A.D.) records " that cattle have an avidity for a salt pasture, and that cows give more milk, that the milk is much more pleasant for curding into cheese than upon ground not of a saline nature."

In England, the use of salt for fertilizing certain crops has been appreciated and practised since the time of Lord Bacon, who mentioned its use in his writings. With the growth of agricultural chemistry during the nineteenth century, many experiments were carried out with the object of obtaining more precise information as to the mode of action of salt, and the practical and economic benefits to be derived from its application. One of the most important points upon which information was desired, was the possibility of substituting the cheaper sodium salts for the more expensive potassium salts, which were, and indeed still are, widely used as fertilizers. It is a remarkable fact that, since the statements of agriculturists in the middle of last century until the development of modern plant physiological technique during the past ten years but little progress appears to have been made in elucidating the true position. It is of interest to quote two such diametrically opposite statements and to examine the several lines of attack that have produced so much confusion in the literature of the subject during the present century.

The first is taken from " A Muck Manual for Farmers," by S. L. Dana, published in 1851:

> " It is a well established fact, that plants growing on soil containing a due mixture of earthy ingredients, always select a due proportion of each, according to their functions; yet, if to such a soil, an excess of either of the alkalies, or of the alkaline earths be given, an excess of potash, soda, lime, magnesia may be taken up by the

plants, to the exclusion of the usual proportion of either; hence it may be established as the seventh principle of Agricultural Chemistry. *ONE BASE MAY BE SUBSTITUTED FOR ANOTHER, IN AN EQUIVALENT PROPORTION* . . . . . It is a fact of the highest practical value."

In 1879, the following appeared in a book " On Artificial Manures," by G. Ville:

" From a chemical point of view the closest resemblance exists between potash and soda. In nearly all the natural compounds which contain potash, soda also is found, and in order to distinguish between the two alkalies, a close acquaintance with the intricacies of chemical reactions is necessary. But to the plant there is a vast difference, for in the experiment in which potash was suppressed and where vegetation suffered so much, the soil was largely provided with soda. It is then an acknowledged fact that soda cannot supply the place of potash."

It might seem desirable to limit statements of " fact " to conditions comparable with those of experiments that have actually been performed. Dr. Voelcker, writing in the 'eighties, realized the complex nature of the problem, pointing out that the beneficial effects of salt were very definitely limited by the crop, some plants responding favourably, like the mangold, whilst to others, such as the potato, it was detrimental. The type of soil he also recognized to be an important factor in determining the value of an application, and indicated that light soils benefited most. It is interesting to find that in 1738 an agricultural expert (" The Practical Husbandman ") had a word to say in this connexion: " As to the proportion of salt to be used on land, it ought to be according to the nature of it; cold, wet, clayey land requiring more; and loose, soft land requiring less." This early writer also recognized the limitations of the plant: " Again the proportion of salt ought to be more or less according to the crops of grass or grain you would improve."

A good example of the difficulties encountered by earlier workers in interpreting the results of experiments with salt may be seen in the account of the trials conducted at Garforth, Yorkshire, from 1901-06. Barley, following roots consumed on the land by sheep, was frequently rank in growth, showing a ready tendency to lodge, and farmers maintained

that the addition of salt to the soil tended to produce a stouter straw and therefore a better standing crop. Salt was applied to a medium loam soil at the rate of 5 cwt. per acre. The first year of the experiment was very dry and there was an increase of 7 bushels of grain and 8¾ cwt. of straw per acre in the plots receiving salt. This result was stated to be due primarily to the action of the salt in retaining soil moisture. In the second year, with sufficient moisture and but little sunshine, the crop receiving salt was slightly worse than the control, both crops became lodged early, and the crop ultimately failed. The third year was extremely wet and yet the plots treated with salt showed an increase in grain comparable with that of the dry year, although with a slightly smaller increase in the yield of straw.

Crowther,[3]* reviewing these results, was led to conclude that further tests were necessary before adequate recommendations could be made to the farmer on the use of salt as a fertilizer for barley. It has now become evident that in the analysis of such experiments several distinct effects must be differentiated.

The effect of sodium chloride may conveniently be studied under two headings: (1) The effect on the soil; (2) The effect on the physiology of the plant. It is well known that the component ions or inorganic salts act on both soil and plant in many respects as separate entities. In analysing the effect of the individual ions†, a great difficulty is at once encountered, for it is not possible to investigate ionic effects singly, but only in pairs. It is due, in large measure, to this basic difficulty of distinguishing between ionic effects that many contradictory statements have originated.

The Effect of Sodium Chloride on the Soil. Soil chemists have found this to be a problem of extreme complexity. Nevertheless at least two main effects seem to be generally accepted at present.

(*a*) Sodium may combine with certain inorganic complexes, particularly in clay soils, and liberate potassium, which may become available for utilization by the plant. Such an exchange of bases in the soil should tend to reduce the quantity

* For references, see p. 246.

† Molecules of simple inorganic substances in solution tend to dissociate into electrically-charged component particles called *ions*. Thus an aqueous solution of sodium chloride will contain positively charged sodium particles or *cations* (Na^+), and negatively charged chlorine particles or *anions* (Cl^-).

of potash that has to be added as fertilizer. This effect was first demonstrated by Lawes and Gilbert,[1] who were able to show the effect of sodium sulphate in increasing the supply of potash to the wheat crop on Broadbalk field. A calculation was made of the total amount of potash taken up by the crop from 1852-71, on plots receiving sodium sulphate, potassium sulphate, and neither soda nor potash. Table I summarizes the data and suggests strongly that the sodium salts had liberated potash from the soil, or had, in some way, enabled the plant to absorb more readily the available potash in the soil.

TABLE I

(from Lawes and Gilbert)

	Control	+ *Sulphate of Soda*	+ *Sulphate of Potash*
Total amount of K_2O taken by wheat crop 1852–1871	569 lb.	832 lb.	1,084 lb.

(All plots received ammonium salts and superphosphate.)

From both soil and plant analyses, agreement with this result is general from the work of Doll[2] on barley, and Krueger[4] on beet and of Stoutemyer and Smith[5] on the soil. Schulze[6] claimed, however, that sodium chloride did not liberate potassium from a potassium zeolite (a crystalline alumino-silicate found in many soils). He concluded that for mustard, at least, sodium must act directly as a nutritive element.

There appears to be some evidence that sodium salts bring about an increase in the phosphorus content of the plant (Wheeler *et al* [7]) and it was suggested that phosphoric acid was liberated from the soil. The carbonate was stated to be most efficaceous in this respect. An actual reduction in the phosphorus content of the plant with chlorides was reported by Shestakov and Shvuidenkov,[8] so that it seems unlikely that sodium chloride will be of direct importance in controlling the level of available phosphorus in the soil.

(*b*) Sodium chloride may bring about a deflocculation of the clay particles in the soil. Thus on heavy land in wet seasons, the soil becomes very sticky and cultivation is made more difficult. This effect is frequently noted at Rothamsted, which has a heavy loam topsoil on a stiff clay subsoil. In 1937, sugar-beet plots receiving 5 cwt. of salt per acre showed this quite clearly. On lighter soils in dry seasons, this effect would be advantageous.

In this connexion also, there are controversial statements in the literature. As recently as July. 1937, Veihmeyer and

Hendrickson[9] stated that "the impervious condition, sometimes observed in the field where the soil was pervious formerly and attributed to the dispersion resulting from irrigation with salty water, may be brought about by mechanical working of the soil when too wet." It should be pointed out that this conclusion was based on laboratory experiments in which soil samples were treated with sodium chloride solutions and then leached with distilled water. It seems probable that the reactions between soil and salt were carried well beyond the stage that normally obtains in the field.

For convenience, one may look upon both the chemical and physical effects of salt on the soil as reversible processes, which tend to reach an equilibrium, the balance of which is determined by both soil and climatic conditions. It is not yet possible to predict with much certainty the response of a soil to salt; where this is possible, as on the intensively-studied soils of our Research stations, it is still almost impossible to forecast the duration of that response.

It has been asserted by Roehmer[10] that the application of chloride fertilizers to the soil should be accompanied by an equivalent dressing of lime. On theoretical grounds it was expected that the chlorides might combine with the lime in the soil to form the highly soluble chloride of calcium, which would be leached away in the drainage waters, thus making the soil more acid. On the Rothamsted soil (E. J. Russell[11]) it has been shown that the application of sodium nitrate prevents the soil from becoming acid. It would be useful to obtain accurate data on the effect of sodium chloride on the acidity of the soil.

One may summarize the response of soils to sodium chloride thus:

Useful.

(1) Potassium may be liberated from many clay soils and this will become available for utilization as a plant nutrient.

(2) A deflocculation of the clay particles is brought about, and this is useful on relatively light soils, tending to increase the water-holding capacity of those soils.

Disadvantageous.

(1) The topsoils of loams and clays may tend to become unduly sticky, particularly in wet seasons, making cultivation difficult.

The Effect of Sodium Chloride on the Plant. A vast body of data has been accumulated by plant physiologists during the past 40 years, purporting to relate to the specific effect of individual ions upon the plant. In these records one finds agreement on certain effects due to sodium or chloride ions, and flat disagreement on others. As has already been pointed out, much of this confusion has been due to the difficulty of distinguishing between the effect of cation and anion, and to the disregard of possible interactions between ions studied and the other mineral nutrients present.

Whilst not dismissing all these data as valueless, it must nevertheless be admitted that without carefully planned experiments performed with plants growing in sand or water culture at known levels of all the mineral nutrients, little real progress can be made. Complex experiments of this type, unfortunately, entail much labour, and the data require lengthy statistical examination. Experiments along such lines are now being carried out at Rothamsted.

Despite many criticisms, certain effects attributed to sodium and to chlorides respectively, do appear fairly consistently in the earlier work. A brief review of these is presented below.

When potash is present in small amounts, addition of sodium is able in some way to bring about an increase in the growth of the plant . . . . . This statement, with variations, has been made by many workers, most of whom do not appear to have distinguished very carefully between the effect on the soil and on the plant. Hartwell *et al*,[12] working at the Rhode Island Experimental Station, claimed to have established this point for both plants in pot culture and in the field. Roehmer[10] stated that potassium might be replaced to some extent in the sugar-beet by sodium, particularly in the leaves. The suggestion was made that such a replacement might tend to make a greater proportion of the potassium in the plant available for root development.

It is certain that sodium is not able to replace potassium completely within the plant. Sodium itself does not appear to be an essential element for normal growth and fruition, yet it is almost invariably present in plant tissues. In the tops of sugar-beet, more than 20 per cent. of the ash may consist of sodium (as Na_2O).

Shih,[13] working at Rothamsted under the direction of Professor Gregory, has demonstrated that sodium has a specific effect on the growth of barley in sand culture. The

response of the plant to sodium was shown to depend on the relative amounts of potassium, phosphorus, calcium and other nutrients present. There is evidence of such interactions to be found in the data of the field experiments at Rothamsted and other centres. In a manurial trial with sugar-beet[14] it was found that the highest yield of roots was obtained when phosphate, potassium chloride and sodium chloride were applied together. Potassium and sodium chlorides, when applied together, have sometimes been found to give a significantly greater sugar percentage in beet roots than when applied separately.[15]

TABLE II

SUGAR-BEET DATA FROM ROTHAMSTED ANNUAL REPORTS, 1929–1934
Plots receiving equivalent quantities of potassium and sodium chlorides (on a chloride basis). Salts applied less than one week before the seed was sown

Location	Date	Roots Sugar %		Roots Tons per Acre		Std. Error
		NaCl	KCl	NaCl	KCl	
Rothamsted—						
No superphosphate	1929	18·40	18·34	7·55	7·41	0·151
+ ,,	1929	18·35	18·39	7·54	7·36	0·151
Moulton	1930	17·81	17·52	11·85	11·76	0·137
Woburn—						
No superphosphate	1930	19·29	19·36	9·98	9·24	0·397
+ ,,	1930	19·33	19·46	9·18	9·21	0·397
Rothamsted ..	1930	17·45	17·65	7·57	7·53	0·129
Wye	1931	18·63	18·68	11·31	10·82	0·169
Doncaster	1934	17·04	17·03	8·77	8·21	0·197
Rothamsted ..	1934	17·56	17·74	15·82	15·43	0·379
Mean		18·21	18·24	9·952	9·663	S.E. of Mean 0·086

It has been a matter of some dispute as to whether potassium or sodium chloride is the more advantageous fertilizer for sugar-beet. Manurial trials have been conducted both at Rothamsted and at other centres in this country, since 1929, to investigate the effect of equivalent dressings of these two chlorides on the sugar-beet. In any one of these experiments, no significant difference has been found between the yield of crops so treated. Nevertheless small differences have been recorded, and with the accumulated data of nine experiments it has been possible to show that sodium chloride does in

fact give a significantly greater yield of roots (as tons per acre) than an equivalent application of potassium chloride. These results are presented in Table II.

The increase in the roots was not large, being about 0.29 ton per acre (average for 9 experiments), an increase of approximately 3 per cent. in the total root weight. The difference in the sugar content of the roots was small.

This result establishes the fact that sodium has a real effect in the field, but does not show whether the result is directly due to an effect of sodium on the plant or is due to an indirect effect upon the soil. In view of the relative cheapness of agricultural salt compared with potash salts, this is an important result. Nevertheless, it must be remembered that increasing the sodium content of the soil, even for plants that are very tolerant of salt, is not likely to prove profitable unless the level of other nutrients in the soil is also raised. Further work is necessary to determine the relationship between the several nutrient salts in their effect on the plant.

The following gives a brief indication of some of the recorded chloride effects:

(1) It has been demonstrated that chlorides are essential for the normal development of Indian corn (Mazé[16]) and also for buckwheat, but with other plants there appears to be some uncertainty as to the necessity of chlorides for normal development. In English soils, certainly, there is not likely to be an actual deficiency of chlorides, since considerable amounts of common salt are deposited with the natural rain.

(2) Chlorides within the plant usually increase in amount from the roots to the leaves, being most abundant in succulent parenchymatous tissue. It is especially abundant in fleshy roots (Jung[17]). The association of chlorides with increased succulence has been noted for cereal straw by Russell,[11] and for potato leaves by Watson.[18] In tobacco leaves, Wilson[19] has demonstrated that when the concentration of chloride is maintained at the limits of tolerance, the leaf may be 2½ times its normal thickness. This thickening is due solely to an enlargement of the cells and not to an increased number of cells.

(3) The plant tends to resist desiccation when treated with chlorides (particularly with sodium chloride)—this has been reported for mangolds (Christensen[20]), wheat, oats and barley (Harter[21]) and for tobacco (Garner[22]).

(4) Concerning the general growth and yield of plants, there

is little satisfactory evidence that chlorides, as such, can bring about any material increase. Tottingham[23] and Lipman *et al*,[24] who have investigated the effects of various chlorides, failed to obtain consistent results, and attributed this largely to the action of climatic and meteorological factors, which appear to control the response of the plant to chlorides.

In field experiments with barley, on the effect of various nitrogenous fertilizers on the yield of grain, Russell and Bishop[25] record that ammonium chloride gave a better yield than ammonium sulphate when these fertilizers were applied at equivalent rates (i.e., on a nitrogen basis). This must not be taken as indicating that the chloride ion is more effective than the sulphate ion, since in this experiment, on an ionic basis, twice as much chloride as sulphate was applied.

It must be concluded that the application of chlorides to the plant is not in itself likely to produce any marked response, although the metallic ions with which the chlorine will be associated undoubtedly exert an influence upon the growth and yield of the plant.

Summary. The effects of sodium chloride upon the plant may be summarized thus:

Useful.

(1) The sodium ion has been demonstrated to be a useful, though not always essential, plant nutrient. The response of plants that are tolerant to salt (mangolds, oats, sugar-beet, asparagus, etc.) may be expected to be controlled by the levels of the other plant nutrients (lime, phosphate, potash, etc.) in the soil.

(2) At Rothamsted, sodium chloride has been found to be slightly superior to potassium chloride for sugar-beet, an increase of 0.29 ton of roots per acre being recorded as the average of 9 experiments. It is not yet certain whether this result is in part due to the effect of the salt on the soil, or whether it is entirely due to the action of salt in the metabolism of the plant.

(3) In dry seasons there is some evidence to show that sodium chloride increases the drought-resisting properties of the leaves.

Disadvantageous.

(1) Chlorides exert a harmful effect on the yield and quality of potatoes (Russell[11]).

(2) High concentrations of chlorides exert a deleterious effect on vegetation and may even be useful as weed killers.

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THE EDUCATIONAL AND RESEARCH SCHOLARSHIP SCHEMES OF THE MINISTRY*

The extent and variety of the facilities available under the scholarship schemes of the Ministry may not be generally appreciated, and in this article a brief description is given of this important part of the agricultural education service of the country. The awards offered by the Ministry are of two kinds, namely: —

(*a*) educational awards,
(*b*) research awards.

Educational awards comprise (i) scholarships for the sons and daughters of agricultural workmen and others, (ii) post-graduate agricultural scholarships, and (iii) refresher course grants, while under research awards are included (i) agricultural research scholarships, (ii) studentships for research in animal health, (iii) veterinary scholarships, and (iv) travelling research fellowships.

Educational Awards. (i) *Scholarships for the Sons and Daughters of Agricultural Workmen and Others.* The scheme of scholarships for the children of rural workers provides increased educational facilities for a section of the community whose opportunities for further education would otherwise be somewhat limited. By the prospects of advancement that the scheme affords, much of the intelligence and enterprise which might otherwise be attracted to urban occupations are retained in agriculture, and the scholarship scheme therefore makes some contribution towards the solution of the problem of the drift from the countryside to the towns.

By the Corn Production Acts (Repeal) Act of 1921 a special

* This article deals only with scholarships of which awards are made direct by the Ministry. The cost of these does not represent the total provision by the Ministry for scholarships. Some £40,000 is expended annually by County Councils in England and Wales on agricultural scholarships towards which annual grants amounting to some £24,000 are made by the Ministry.

fund of £850,000 was provided for the promotion of agricultural development in England and Wales, and it was felt that out of this fund some definite provision should be made for the benefit of workers on the land and their families. To this end, under the objects to which the fund was to be applied was included "the establishment of scholarships and maintenance grants for the sons and daughters of agricultural workmen and others." A Departmental Committee composed of representatives of the Ministry and the Board of Education drew up a scheme to give effect to this provision, and their recommendations were based on the assumption that £100,000 out of the total sum provided for England and Wales would be devoted to the purposes of the Scheme for a five-year period commencing April 1, 1922. The Scheme was approved by H.M. Treasury as an experimental measure for this period. Although this Scheme was due to expire at the end of 1926, it had been so successful that it was continued from that date on a permanent basis.

The main objects of the Scheme are (*a*) to provide facilities for the children of agricultural workers to obtain some technical training in agriculture; (*b*) to improve the standard of agricultural production by returning annually to the industry a body of young men and women, skilled in agricultural practice and with some knowledge of its scientific basis; and (*c*) to qualify the children of agricultural workers with good secondary school records for teaching, administrative or advisory posts in agriculture by providing facilities for their further education in agriculture or an allied science at a university or agricultural college. Awards under the Scheme are confined to the following:—

(*a*) sons and daughters of agricultural workmen and working bailiffs and of smallholders and other rural workers whose means are comparable with those of agricultural workmen; and

(*b*) *bona fide* workers in agriculture.

The number of scholarships offered for award each year is approximately as follows:—

120 Junior scholarships.
10 Extended Junior scholarships.
10 Senior scholarships.

The *Junior* awards are for courses of from 1 to 4 terms in agriculture, horticulture, dairying, or poultry husbandry, and are usually tenable at farm institutes and agricultural colleges.

Candidates for this class of award must be 16 years of age and should have been engaged for a period of at least one year in practical agricultural work. The *Extended Junior* awards are reserved for students who have already held Junior scholarships, and who have shown that they are capable of benefiting from a more advanced or specialized course of study. The duration of these awards is 1 year. The *Senior* awards are available for candidates who have held Junior scholarships or have attended a farm institute course by other means, or have passed a Higher School Certificate examination, and are awarded for degree or diploma courses in agriculture or an allied subject (including veterinary science).

All awards cover the whole cost of instruction while students are at the training institutions, and, in addition, provide for the payment of allowances on a scale sufficient to meet ordinary living expenses at the institutions concerned. Details of the Scheme are widely advertised annually during March, and applications must be submitted not later than April 30. Applicants are required to forward their applications through the Agricultural Education Authority for the county in which they reside.

The administration of the Scheme is in the hands of the Central Scholarships Committee, which includes representatives of agricultural labour organizations, universities, agricultural colleges, farm institutes, local authorities, and the Board of Education. Since the inception of the Scheme, the Committee has spared no effort to make it of the greatest possible benefit to the class for which it was intended. It has endeavoured to make adequate provision for the special needs and circumstances of individual scholars; and its success in this respect and the wisdom of its selections are amply illustrated by the examples of the results of awards given below. The Chairmanship of the Committee since 1927 has been held by Mr. W. R. Smith, J.P., who was one of the members of the original Committee.

In attempting to assess the full value of the Scheme, it is of importance not to overlook its indirect effects. One cannot estimate fully the value to the industry of the broader outlook of the scholars, the receptivity to new ideas which they have derived from their education, and their influence over their fellow workers, but the after-careers of the scholars provide some indication of the direct results.

Educational and Research Scholarships

During the 16 years in which the Scheme has been in operation, assistance has been granted to more than 1,700 individuals involving the award of 2,021 scholarships. Of these, 97 were for Degree courses extending over 3, 4 or 5 years, 107 for two-year Diploma courses and 1,817 for Farm Institute courses. The distribution of the awards among the various classes of beneficiary is as follows:—

	1922–1936	1937	*Total*
Sons or daughters of agricultural workmen ..	503	30	533
Sons or daughters of working farm bailiffs ..	148	20	168
Sons or daughters of smallholders	465	28	493
Sons or daughters of other rural workers ..	288	11	299
Candidates who qualified on their own account as *bona fide* workers in agriculture	483	45	528

The after-careers of the 1,472 scholars who have completed courses of instruction have been followed up. All but a very small percentage have returned to agricultural employment, many succeeding in improving their positions substantially, and a number obtaining important posts, scientific and otherwise, in the agricultural industry. The latest information shows that about 11 per cent. (principally ex-Senior students) hold administrative, teaching, research or advisory appointments of an agricultural nature, while a further 17 per cent. occupy posts of a supervisory character such as managers of farms, nurseries, dairies and so on. Ex-scholars who are employed in practical agricultural work amount to 50 per cent.; 4 per cent. are working on their own account as smallholders, nurserymen and dairymen. Those who have obtained employment outside the industry number only 6 per cent.

Further details of employment are as follows:—

Administrative, teaching, research or advisory appointments of an agricultural nature either at home or abroad	163
Veterinary surgeons	3
Agricultural posts of a supervisory character (e g., managers or foremen of farms, nurseries, dairies, etc)	247
Working on own account (smallholders, nurserymen, dairymen, etc)	56
Engaged in practical agricultural operations	740
Women who have married	56
Seeking employment at the time of inquiry	50
Obtained employment outside the agricultural industry	92
Died	15
Cannot be traced; probably engaged in agricultural employment	50

Most of those who have held Junior awards have returned to practical agricultural employment, usually to improved positions with higher wages. The following particulars relating to a number of students who completed their scholarships in 1937 give an indication of the improved posts that former Junior students have been able to obtain:—

Before the Award	*After the Award*
Dairyman (29*s*. a week).	Buttermaker (38*s* 6*d*).
Farm worker (33*s*. a week).	Stockman (40*s* a week).
Farm worker (20*s*. a week and board and lodging).	Poultry Manager (50*s*. a week).
Farm worker (26*s*. a week).	Stockman (34*s*. a week).
Farm worker (31*s*. a week).	Dairyman (40*s* a week).
Farm worker (35*s*. a week)	Farm worker (50*s*. a week)
Farm worker (17*s*. a week).	Farm worker (45*s*. a week).
Farm worker (30*s*. a week).	Poultry worker (40*s*. a week)
Cowman (15*s* a week and board and lodging).	Poultry manager (52*s*. a week)

The application papers of the unsuccessful candidates, many of whom are ineligible for scholarships under this scheme, are returned to the Local Authorities from whom they receive consideration in connexion with the award of County scholarships. In 1937, 453 applications were returned for this purpose and 132 candidates were successful in obtaining County awards. Since the scheme came into operation, 970 unsuccessful applicants for scholarships under this scheme have obtained awards from the County Authorities.

POST-GRADUATE SCHOLARSHIPS AND REFRESHER COURSE GRANTS. The educational and advisory work conducted throughout the country by the agricultural staffs of the Local Authorities is of great benefit to the farmer. Agriculture under modern conditions demands the ever increasing application of the best technique, and the agricultural organizer and his staff are at the disposal of the practical farmer in order that he may derive full benefit from the discoveries of research workers in the many sciences that underlie agricultural practice. The maintenance at a high level of the instructional and advisory work in the counties is thus of vital importance, and it is the aim of the two schemes described below to assist in this direction. Awards under the Schemes are offered by the Ministry in conjunction with the Department of Agriculture for Scotland.

(A) *Post-Graduate Agricultural Scholarships*. This Scheme of scholarships originated in 1924, was abandoned in the financial

crisis of 1931, and revived last year in a modified form. The object of the original scheme was to further the agricultural education of students who proposed to take up posts as agricultural organizers, teachers and lecturers, and 3 or 4 two-year scholarships were awarded annually. The first year of the award was spent in this country, and the student was expected to broaden his knowledge of general farming conditions, and, in addition, to make a special study of some particular branch of agriculture. The second year was normally spent abroad, and generally included a course at an agricultural college, having special reference to that branch of agriculture to which the student had devoted his attention in his first year.

Thirty-nine scholarships were awarded in the years in which the original scheme was in operation (1924-31), but very few of the scholarship-holders went into the agricultural educational service. Many found posts in research and provincial advisory services, which were undergoing expansion during the period; some found employment in connexion with the marketing work of the Ministry, and one ultimately became Chief Marketing Officer to the Milk Marketing Board, and another, Marketing Officer to the Potato Marketing Board. In spite of the marked success of the scholarship-holders as individuals, it was apparent that the original object of the scheme was not achieved. The need, however, remained for a scheme that would train students for the post of agricultural organizer, instructor or lecturer by broadening their agricultural knowledge and experience and by giving them an opportunity of gaining the closest acquaintance with the practical side of teaching and advisory work; and the scheme in a modified form was therefore revived last year.

The candidates are usually required to be graduates of a university, although exceptional candidates otherwise qualified, but who have not had an opportunity of graduating are also considered. Each year 4 scholarships are awarded, up to a maximum value of £200 each, together with an allowance for fees and travelling expenses. The value may be varied in accordance with the student's means and may cover the whole of the cost of training and maintenance or only a proportion. The period of the scholarships is for one year and commences on October 1, and is spent at agricultural educational institutions or advisory centres or farms approved by the Ministry or the Department. Candidates are required

to be nominated by a Professor, Principal, or Lecturer of a University or College and the latest date for receiving nomination is June 1.

(B) *Refresher Course Grants.* A number of Refresher Course grants is offered each year to persons already engaged in county agricultural educational work. Their purpose is to provide recipients of awards with the means and opportunity to widen their knowledge of particular branches of agriculture and to become acquainted with recent advances on the scientific side of the subject. The period of the course is normally about 4 weeks, but may be extended to 8 weeks, and is usually spent at agricultural educational or research institutions or advisory centres or farms approved by the Ministry or the Department. The maximum amount of each grant does not exceed £25.

(*To be continued.*)

MAIZE AND ITS CULTURE IN ENGLAND

W. SOUTHWORTH,
Rothamsted Experimental Station

During recent years a certain amount of interest seems to have been aroused regarding the possibility of growing maize in this country not only as a fodder crop but also as a vegetable in the kitchen garden.

One of the chief causes acting against the spread of maize culture in England is perhaps due to the common practice of sowing seed obtained from varieties grown in a warm, sunny climate specially suited for the growth of maize, the resulting crops from which, in our cool, cloudy and damp climate, have not been altogether encouraging.

The question sometimes arises as to whether, by a suitable selection of promising varieties, there is a possibility of developing a strain of maize that may in time become sufficiently acclimatized to English conditions to make a profitable crop to grow in an average run of seasons.

Origin of Maize. The exact source of maize is not yet known, but undoubtedly the plant is of very ancient origin. Most authorities are now agreed that it originated by the natural crossing of two wild plants in the wilds of Mexico. The first authentic account we have of maize is that left by Columbus when he discovered America, where he found the crop being widely cultivated by the native Indian tribes.

Adaptability. Maize is often considered to be a tropical or at least a sub-tropical plant, but there is good evidence to show that it has very wide adaptation properties. The crop is extensively grown in the hot semi-arid southern regions of the United States, and, as one travels from the South-Eastern States north-west through the Middle States on to Minnesota and North Dakota maize is found to be a leading farm crop throughout. It has also crossed the border into Canada and now crops of mature maize are grown 200 miles northr of Winnipeg. We have therefore good reasons for emphasizing that there exists a strong possibility of the

development of varieties and strains of maize that may ultimately become acclimatized to many different climatic conditions.

Variability. There are at least six well defined groups of maize and probably three distinct sub-groups in each of the main groups. In each of the sub-groups there is a long list of named varieties and strains that have been developed for special purposes. For example, the large heavy-yielding types, 10-12 ft. or more in height, with large-sized ears and grains, are grown in districts where climate and soil are favourable for rapid growth and high production. In cooler climates these heavy croppers are quite unsuitable and the grower must be content to have much smaller kinds from 3-6 ft. in height, with correspondingly small ears and grains that develop fairly quickly in a moderate degree of temperature and produce quite satisfactory crops. The starchy-grained varieties are most widely grown, and it is from these that the great bulk of grain is produced as food for man and beast. The varieties of Sweet Corn are not nearly so numerous, and are not so widely cultivated on a large scale. In the United States, however, nearly every kitchen garden has its plot of Sweet Corn, and farmers and market gardeners frequently grow a field plot from which they market the first crop of ears as they become ready for table use, while the remainder of the total crop may be harvested and made into silage or tied into bundles, stooked up and used as dry forage.

Even after due consideration of the variability and wide adaptation of maize, one must acknowledge that we have not yet succeeded in finding a single strain that seems to be quite at home in England and which matures fully during a series of years. It would seem, however, that by a prolonged course of breeding and selection of suitable parents and, if necessary, by inter-crossing of varieties, a strain of maize might eventually be built up and fairly well acclimatized to the variability of our English climate. With this end in view, preliminary trials were commenced in 1934 at the Rothamsted and Woburn Experimental Stations.

Rothamsted and Woburn Experiments with Maize. The two varieties first selected to be tested in 1934 were both of the starchy-grained group and belong to the sub-group known as Flint Corn; in this sub-group a large percentage of

the starch in the grain is hard and flinty in contrast with the soft, floury nature of the grain in many of the other members of the starchy-grained group. The flinty-grained varieties contain some of the hardiest and earliest maturing strains in cultivation. There is, therefore, good reason for beginning operations with hardy, quick growing strains, and those which give most promise of success in producing fodder corn having a high feeding value.

In maize-growing countries it has been repeatedly proved by practical feeding trials that the food nutrients in a maize crop increase steadily up to the stage of complete maturity, from which we may conclude that a variety or strain of maize that will mature readily in this country will enable our farmers to grow a crop from their own seed, and, moreover a crop having a much higher feeding value than the watery immature crops produced from foreign-grown seeds.

The varieties tested in 1934 were *Manitoba Flint* and *Manalta;* both of which are yellow flints, produced and developed by hybridization and selection during the years 1916-28 at the Manitoba Agricultural College, Winnipeg.

MANITOBA FLINT. This is an early, semi-dwarf, 12-rowed variety: breeds fairly true to type; was developed by straight selection from an old Canadian variety known as Quebec yellow. Average height of plant 5-6 ft., and very leafy. In Manitoba it produces a crop of mature seed in 100-105 days. The average annual yield over 4 years for mature ears was 4,108 lb. per acre. Immature ears yielded 1,010 lb. per acre. Total crop green weight was 12-15 tons per acre.

MANALTA. This variety was developed from the progeny of a cross between Manitoba Flint ♂ male parent and Howes Alberta Flint ♀ female parent. The female is a dwarf 8-rowed variety and a very early maturing type. From this cross, by using a method of careful selection, the Manalta variety was produced. Like its female parent, Manalta has 8 rows and in height the plant is intermediate between that of the two parents; it produces an abundance of leaves together with a good crop of early maturing ears; it also shows a tendency to develop grains in the male or pollen-bearing flowers in the tassels. The average height of plant is 4-5 ft. Total yield per acre averages 10-12 tons, while weight of ears per acre (after husking) calculated on a 4 years average in Manitoba was 4,113 lb. for mature ears and 337 lb. for immature ears.

In Manitoba, the Manalta variety will produce a mature crop with ripe seed in 80-90 days and is therefore especially suited to districts having a short summer season. As evidence of the suitability of Manalta maize for crop production in Canada it may be pointed out that it is one of the few varieties of Canadian maize recently considered to be worthy of registration by the Canadian Seed Growers' Association.

Manitoba Flint and Manalta Maize at Woburn. In the first trials of these varieties in 1934 both produced excellent crops and well ripened grain. With regard to yield of fodder, Manitoba Flint was decidedly better than Manalta, but Manalta had the advantage in respect of early maturity. Manalta was planted again at Woburn during the past three years 1935, 1936, 1937. On the behaviour of Manalta at the Woburn Station the following extracts from the 1937 Report of Dr. H. H. Mann, Assistant Director at Woburn, may be quoted. "We had an excellent crop from the Manalta maize and if there had not been so much damage by birds we should have got an astonishing weight of grain. It was an excellent crop, the best I have had up to the present. The crop was taken on land which had been treated with a good dressing of farmyard manure in the previous winter. It was sown by dibbling on April 28 and was reaped in the last week of September. The grain was perfectly ripe and hard and there is no doubt that this year there was no difficulty in maturing this variety of maize."

Although the Manalta is a distinct Flint type and is rightly classified in the starchy group, yet, when it is recalled that in its early history one of its parents was a Sweet Corn, it is not surprising that it possesses some of the sugary characteristics of the true Sweet Corn. If gathered at the correct stage for cooking Manalta is not greatly inferior to the true Sweet Corn, but if it is allowed to become a little too mature before gathering it begins rapidly to lose much of its sweetness and develops a starchy flavour which renders it somewhat flat and unpalatable for table use.

Varieties of Sweet Maize at Rothamsted. In 1935 it was decided to test some of the early maturing varieties of Sweet maize suitable for the kitchen garden. For this purpose three varieties were selected: (1) Golden Bantam; (2) Dorinny; and (3) Pickaninny. The Golden Bantam is

an old, well-known favourite; it is yellow-seeded, of excellent quality, but takes rather longer to mature than either of the other two, which are both distinctly early maturing varieties. This preliminary test seemed to show that, considered as a whole, the Dorinny was probably the most desirable variety to cultivate, and consequently seed was saved to continue the trials in the following year, 1936. That season, which proved to be uncommonly wet and cloudy, even for England, provided a severe test of the ability of any variety of maize to produce mature grain. The Dorinny, however, came through the test in a very surprising fashion and yielded excellent seed, having a high germination power.

The Dorinny is a yellow-seeded hybrid developed at the Central Experimental Farm, Ottawa. It is semi-dwarf in habit, is earlier to ripen than Golden Bantam and yields a good crop. The Pickaninny is an old well established variety both in Canada and the United States. It is distinctly of dwarf habit, the ears are small, the grains blue, and it is usually considered to be one of the earliest varieties in cultivation. The Dorinny was produced by crossing with Pickaninny and then by careful selection to isolate a pure yellow-seeded strain.

Like the soya-beans, maize was slightly nipped by frost on May 27, 1936, but little damage was caused and the crop readily recovered. A hail-storm in June shattered a few of the outer leaves, but not sufficient to cause serious injury. Owing to the wet and cool weather, however, the plants developed very slowly. Some damage was caused by sparrows, which attacked the ears when grains were in milk ripe condition. Some of the best ears were protected and a few fairly well ripened ears were gathered from both varieties. Grains from a number of the best ears were tested for germination power, and about 75 per cent. of those tested gave 100 per cent. viable grains.

When considered from the point of view of general utility, Dorinny seems to be the most promising type; it matures early and is of excellent quality for the table. Pickaninny may probably take a rather shorter time to mature than Dorinny, but the blue colour of the grain renders the ears less attractive for culinary purposes.

In the experiments at Rothamsted in 1937, in order to avoid the possibility of cross pollination, only one variety, Dorinny, was planted. It may be mentioned that in 1935 the Dorinny

(by mistake) was planted on a plot adjoining Golden Bantam maize and as neither variety was detasseled it is almost certain that they intercrossed. As, however, both varieties are sweet, early ripening, and yellow, no serious damage resulted, and in 1935 and again in 1936 seed from the best matured ears was selected to continue the crop.

The seed was sown on two different dates, viz., April 29 and May 6, 1937. On the whole, the early seeding gave the more satisfactory returns both in early maturity and weight of crop. During the early part of the season the crop developed slowly, but in the hot days of July and August growth was fairly rapid and a few plants were beginning to tassle on July 7. About the first week in September a few ears were well formed and in a suitable condition for table use. The general harvesting of ears for seed commenced on October 22, and was almost completed the following day.

Cultural Methods for a Small Plot. SOIL AND SITUATION. In an average English climate, with a good sunny situation and careful management, maize will succeed on a great variety of soils. A well drained, free working loam suitable for potatoes is very suitable for maize. Soils inclined to be heavy should be opened up by deep digging in the autumn, and long, strawy farmyard manure should be worked in during the digging. In spring, the cultivation consists in breaking up the surface soil, using methods similar to those practised in preparing land for potatoes, in order to have the land ready to plant by about the first week in May.

MANURES. If the land has been manured in the autumn with about 15 tons of farmyard manure no further application will be required. If the seed is sown in a soil in good heart after a crop of potatoes a dressing of artificials will be quite sufficient, e.g., about 4-5 cwt. superphosphate and 1-1½ cwt. sulphate of potash per acre, applied just before sowing. Should the plants appear to require a little stimulant, about ½ cwt. of nitrate of soda may be used. Care should be taken, however, not to force the crop too strongly, as there is danger of producing a rank growth of stem and leaf, which inhibits the quick development of ears and greatly retards early maturity.

SOWING. Taking the average run of seasons, about the first week in May is usually a suitable time to sow the seed. Alternatively, two sowings may be made, one about the first

week in May and another about ten days later. The seed may be sown in rows 18-20 in. apart, the seeds being 8-9 in. apart in the rows. Another method is to sow seed in groups or hills, 4-5 seeds to each hill. The hills may be spaced 3 ft. apart in the rows, with 18-20 in. between the rows.

Another method consists of sowing the seed in pairs side by side about 2 in. apart, and when the plants are well up about 4-5 in. high the weaker plant of the pair should be taken out and discarded. This method usually ensures a good uniform stand of plants and also assists in building up a strong, vigorous strain of seed.

AFTER-TREATMENT. When the plants are well above ground, the soil around them may be lightly stirred to break the crust and destroy seedling weeds. The plants should at this stage be growing rapidly, and when 4-5 in. high those that are in pairs should be singled down, taking care not to disturb too greatly the one left to grow. Summer cultivation consists in surface hoeing to keep down weeds and form a surface mulch. In most varieties of Sweet maize there is a tendency to produce a number of extra side shoots or tillers, usually called suckers, which arise from the base of the main stem. These tend to weaken the main stem, which bears the best ears. They may easily be split off by pushing the forefinger down to the base of the main stem, grasping the sucker and giving it a sharp side twist. As a rule, the sucker breaks away without doing any serious injury to the plant.

HARVESTING EARS FOR TABLE. For use in the kitchen, the ears should be gathered when grains are in the milk-ripe stage when the husk that encloses the ear is quite green though the silks are becoming brown and shrivelled. To make certain that the grains are at the correct stage, the husk should be opened up slightly and grain tested with thumb-nail. If the grains appear to be fairly plump and well formed, and if on slight pressure a white, sweet, milky fluid escapes, the ear may be considered to be fit for cooking.

HARVESTING AND STORING EARS FOR SEED. For seed purposes, the ears should not be harvested until grains are hard and dead ripe. At this stage the husk surrounding the ear becomes dried up and shrivelled and grains are bright and glistening. These ripe ears may be stored in various ways. A good simple method is to pull the husks back from the point of the ear to over-lap the base, then tie three or

four ears together in a bunch and hang the bunches in a warm, airy room to dry. Care should be taken to dry the ears thoroughly and fairly quickly, otherwise moulds, which would probably ruin the grain for seed purposes, are likely to develop.

On no account should the grain be shelled from the cob until both grains and cob are completely dried out.

If well developed ears have been harvested and properly stored, the seed will retain its germination power for several years with only a slight deterioration.

NOTE ON SEED SUPPLY Small quantities of seed may be obtained by County Organizers and Farm Institutes for local trials from the Director of the Rothamsted Experimental Station.

THE UPTAKE OF NUTRIENTS BY BRUSSELS SPROUTS

A. H. Lewis, Ph.D., B.Sc., F.I.C.,

Imperial Chemical Industries Ltd., Jealott's Hill Research Station, Bracknell, Berks.

Apart from a paper by Liesegang,[1]* very little information seems to be available regarding the rate of uptake of nutrients by the sprout crop. Liesegang's results show that uptake of N, P and K was most rapid in September and October, after which there was a loss of N and K. While this loss may have been partly due to decomposition of fallen leaves (which were collected and included in the yield and composition figures), there may have been a direct transfer of N and K from the living plant to the soil, as has been demonstrated by Deleanu and others.† There was no apparent loss of Ca or P; uptake of Ca ceased early, but uptake of P continued to the end of the experiment.

In Bulletin No. 71 of the Ministry of Agriculture and Fisheries, the following figures are given for the amounts of nutrients removed by a crop giving 3.5 tons of sprouts per acre:—

60 lb N, 18 lb P_2O_5, 66 lb K_2O

These figures obviously refer to the sprouts only, and since in this country it is common to remove the whole of the crop from the land, the actual amounts of nutrients removed from the soil are much greater.

It was decided, therefore, to investigate the problem and to this end an experiment was conducted in 1934 and 1935 at Datchet, Bucks, on alluvial soil in very good heart. This soil is typical of the market gardens in the neighbourhood. In the season preceding the experiment, the soil carried a very heavy crop of clover.

The results given below refer to the control (no nitrogen) plots of an experiment involving twelve treatments. Phosphates and potash were applied in both years. In 1934,

* For references, see p. 268

† See review by F. L. Penston, *Nature*, 1938, VIII. 17

25 cwt. superphosphate and 7 cwt. sulphate of potash per acre were applied in May. In 1935, 10 cwt. superphosphate and 5 cwt. sulphate of potash per acre were applied in March. No nitrogen was applied to these plots in either year, but the soil was in such good heart that nitrogen applied to other plots had only a moderate effect (giving an increase in each year of about 5 cwt. of fresh sprouts per acre). Transplanting was done on June 11 in both years.

Sampling. The individual plots were approximately 1/34th acre in area, and contained 12 rows each of 12 plants. The rows were 3 ft. apart and the plants 3 ft. apart in the rows.

One half of each plot was treated in the normal market garden manner (i.e., the sprouts were picked when they reached a marketable size and the lower leaves were stripped off as necessary), whilst on the other half-plot, which was reserved for sampling purposes, the sprouts were not picked and the lower leaves were not removed, i.e., the sample plants were complete except for some natural leaf fall at the end of the season.

Six plants were taken at random (one from each of six rows) at monthly intervals from each "sample" half plot. In 1934, the plants were divided into (i) leaves and sprouts and (ii) stems and roots, and, after being weighed, samples were taken from each half-plot for dry matter and nitrogen determinations; analyses for P_2O_5, K_2O and CaO were conducted on composite samples. In 1935 the plants were divided into (i) sprouts, (ii) leaves and (iii) stems and roots; the produce from sets of three plots was bulked, thereby reducing the number of effective replicates to two, and dry matter determinations and chemical analysis were conducted on these two replicates.

Weather. Monthly figures for rainfall and sunshine are given in Table I. The author is greatly indebted to the late Mr. Richard Bentley for supplying the weather data for January, 1934, to May, 1935. The percentage moisture contents of soil samples (0-6 in.), which were taken at the same time as the plant samples, are also included in the table. These results are for soil samples taken at the end of each month except in April-July, 1935, when the samples were taken in the middle of each month.

TABLE I.

	1934			1935		
	Rainfall (in.)	Sunshine (hrs.)	Soil Moisture Content %	Rainfall (in.)	Sunshine (hrs.)	Soil Moisture Content %
January .	1·470	18·5	—	0·808	21·3	—
February ..	0·128	65·9	—	2·252	48·5	—
March	2·142	107·1	—	0·540	115·2	19·8
April . ..	1·528	129·3	14·9	2·943	121·75	13·3
May . ..	0·392	184·0	9·3	1·202	190·0	18·1
June . .	1·120	204·25	9·3	4·045	187·4	12·9
July ..	1·505	262·2	11·3	1·390	265·9	9·6
August .	2·710	164·3	17·0	1·850	186·4	17·7
September .	1·412	167·0	11·3	3·655	151·8	18·1
October .	1·578	64·7	12·0	2·690	104·0	16·5
November	2·082	18·7	16·9	4·535	56·3	19·0
December .	5·562	6·3	18·0	0·24	20·1	19·2

Results. The most striking point about the results, which are given in Tables II and III, is the magnitude of the nutrient content of the crop. The amounts of nutrients removed from the soil are much greater than with such gross feeding crops as potatoes and mangolds.

The crop took up only small amounts of nutrients for the first two months. During August and September the uptake of all nutrients was extremely rapid, and it is obvious that the crop needs a very large supply of available nutrients during this period. Except on extremely rich soils, heavy dressings of complete (N, P, K) fertilizers should prove very effective if applied 4-6 and 8-10 weeks after transplanting.

There is no evidence of a transfer of N or K back to the soil in the late stages of growth, as found by Liesegang (loc. cit). The results show that uptake of N and P took place right up to the time of removing the crop, whilst uptake of K appeared to cease after October.

Calcium behaved quite differently from N, P and K. The calcium content of the crop increased until September-October, and then showed a marked decrease. The 1935 results show that this decrease in Ca was entirely due to the loss of dead leaves. No such decrease occurred with N, P or K, and the results indicate that N, P and K were translocated from the moribund leaves to the developing sprouts. The sprouts were high in percentage content of N, P and K, but very low in Ca. Only a small amount of Ca is needed by the

TABLE II.—YIELD, CHEMICAL COMPOSITION AND NUTRIENT UPTAKE 1934

		Plants	July 4	Aug 1	Aug. 28	Sept. 26	Oct 24	Nov. 22	Dec. 15
Fresh Matter—									
Leaves and sprouts.	Tons/acre	—	—	1·59	7·18	17 17	18·19	22·27	19·69
Stems and roots	Tons/acre .	—	—	0·26	1·67	3·18	3·60	4·38	4·38
Total.	Tons/acre .	0·03	—	1·85	8·85	20·35	21·79	26·65	24·07
Dry Matter—									
Leaves and sprouts	Cwt./acre	—	—	4·03	21 10	48·00	57·17	70·79	57·81
Stems and roots.	Cwt./acre .	—	—	1·18	7·08	13·68	17·26	23·46	22·08
Total.	Cwt /acre	0·12	0·27	5·21	28 18	61·69	74·44	94·25	79·89
N.—									
% of dry matter	.. .	3·02	3·96	4·21	3·53	3·03	2·84	2·80	3·05
lb./acre .. .	.	0·4	1·2	25	111	209	237	297	272
P_2O_5—									
% of dry matter	.	0·494	1·000	1 000	0·914	0·816	0·800	0·808	0·975
lb./acre .. .	..	0·07	0·31	5·8	29	56	67	83	87
K_2O—									
% of dry matter	.	2·70	4·39	4 43	3·79	2 60	2 53	2·24	2·52
lb./acre	.	0 36	1·35	26	120	180	211	237	225
CaO—									
% of dry matter	. .	—	4·27	3·67	4·30	3·58	3·24	2·47	2·32
lb /acre	. .. ..	—	1·3	20	136	247	270	261	208
" True " protein N. as % of total N		72	74	52	53	62	59	64	58
" Organic " P_2O_5 as % of total P_2O_5	..	49	27·5	29	43	44	55	57	53

TABLE III.—YIELDS, CHEMICAL COMPOSITION AND NUTRIENT UPTAKE. 1935

	Fresh Matter Tons/acre	Dry Matter Cwt./acre	Per cent of Dry Matter				Uptake lb per Acre				"True Protein" N as per cent of total N	"Organic" P O as per cent of total P_2O_5
			N	P_2O_5	K O	CaO	N	P_2O_5	K_2O	CaO		
Sprouts												
1 Aug	—	—	—	—	—	—	—	—	—	—	—	—
2 Sept	—	—	—	—	—	—	—	—	—	—	—	—
30 Sept	1·25	3·04	4·80	1·440	4·53	0·85	16·6	4·9	15·4	2·9	53·9	59·8
28 Oct	2·64	8·15	4·51	1·348	5·01	0·58	41·0	12·3	45·6	5·3	54·3	43·0
25 Nov	4·03	12·24	4·75	1·610	4·36	0·44	65·2	22·1	59·7	6·0	53·0	54·3
19 Dec	5·94	17·81	4·63	1·601	4·12	0·52	96·4	31·8	82·1	10·4	51·4	50·3
Leaves												
1 Aug	1·39	4·08	3·90	0·866	3·91	5·08	17·6	4·0	17·9	23·2	70·5	27·5
2 Sept	5·52	13·70	3·64	0·889	3·37	3·95	56·0	13·6	51·8	60·6	65·6	42·2
30 Sept	10·26	27·06	2·73	0·793	3·69	4·92	82·7	24·1	111·8	149·0	66·3	41·1
28 Oct	9·24	29·35	2·39	0·696	2·51	3·83	78·7	22·9	82·5	125·7	57·7	43·7
25 Nov	7·68	23·02	2·59	0·882	2·23	3·88	66·7	22·7	57·4	99·9	65·6	40·2
19 Dec	5·94	18·95	2·55	0·798	2·33	3·30	53·1	16·9	49·5	70·1	64·3	55·4
Stems and Roots												
1 Aug	0·33	1·26	2·35	0·977	3·70	1·19	3·2	1·4	5·3	1·7	54·3	33·9
2 Sept	1·56	4·93	2·80	0·975	3·87	1·71	15·6	5·4	21·4	9·4	49·3	35·8
30 Sept	3·00	13·24	1·89	0·933	3·00	1·10	28·3	13·8	44·5	16·3	56·6	31·6
28 Oct	3·06	14·80	2·10	0·851	2·60	0·78	34·8	14·1	43·2	12·9	55·7	53·6
25 Nov	3·24	16·64	2·14	0·962	2·49	0·68	39·8	17·9	46·5	12·7	50·4	53·3
19 Dec	3·30	16·60	2·23	0·852	2·02	0·73	41·2	15·8	37·5	13·6	48·4	60·3
Whole Plant												
1 Aug	1·72	5·34	3·48	0·894	3·88	4·16	20·8	5·4	23·2	24·9	69·0	29·4
2 Sept	7·08	18·63	3·43	0·910	3·51	3·36	31·6	19·0	73·2	70·0	62·1	40·1
30 Sept	14·51	43·34	2·63	0·881	3·54	3·46	127·6	42·8	171·7	168·2	62·0	40·2
28 Oct	14·95	52·30	2·64	0·841	2·92	2·45	154·5	49·3	171·3	143·6	56·4	46·3
25 Nov	15·61	51·90	2·95	1·078	2·81	2·04	171·7	62·7	163·6	118·6	57·3	48·9
19 Dec	15·19	53·26	3·20	1·081	2·84	1·58	190·7	64·5	169·1	94·1	53·4	53·9

developing sprouts, and Ca, therefore, accumulates in the leaves which ultimately fall. This raises the question, to which Truffaut[2] has recently drawn attention, of the function of Ca *in the plant* as distinct from the rôle of calcium carbonate in eliminating soil acidity. While plants need some calcium for their proper development, the high calcium content of many crops seems to be in the nature of luxury or unavoidable uptake. The plant cannot avoid luxury uptake if the concentration of Ca ions in the soil solution is high, and Traffaut points out that excessive uptake of Ca " is liable to call forth the phenomena of age." In sprouts the plant uses its leaves to rid itself of excess Ca.

Elaboration of N and P_2O_5 into Organic[3] Forms. To obtain an idea of the use made by the plant of the N and P_2O_5 absorbed, " true protein " (Stutzer) N and " organic " P_2O_5 were determined. The results are included in Tables II and III. The ratio of true protein nitrogen to non-protein nitrogen is about the same as for marrow-stem kale and drumhead cabbage Compared with grass and hay,[4] the proportion of " organic " P_2O_5 is rather high.

The ratio of true to crude protein showed a slight fall during the season, whilst the " organic " fraction of the phosphorus showed a steady but marked increase. In their work on pasture herbage, Greenhill and Page[5] observed a correlation between true protein nitrogen and *total* phosphorus content, and remarked: " This suggests that phosphorus may play an essential part in the chain of processes culminating in protein synthesis in the green leaf." The different rates of elaboration of N into true protein and P into " organic " combination found in the present experiment with sprouts, do not appear to confirm Greenhill and Page's suggestion.

Summary. The results of an experiment conducted over two seasons show that a crop of Brussels sprouts removes in one season from the soil extremely large amounts of nutrients viz., 200-300 lb. N, 60-90 lb. P_2O_5 170-240 lb. K_2O and 170-270 lb. CaO per acre.

The crop absorbed only small amounts of nutrients in the first 6-8 weeks after transplanting, but during the third and fourth months of growth very large amounts of nutrients were absorbed (average about 70 lb. N, 20 lb. P_2O_5, 75 lb. K_2O and 95 lb. CaO per month). Owing to this relatively

restricted period of high demand for nutrients in an available form, heavy dressings of complete (N, P, K) fertilizers should be highly effective if applied about 4-6 and 8-10 weeks after transplanting.

The nitrogen and phosphorus contents of the crop increased until picking of the sprouts was completed, but the uptake of potassium ceased after October.

The calcium content of the crop increased rapidly to a maximum in September-October, and then showed a marked decrease due to leaf fall. Absence of a corresponding decrease in N, P and K shows that these elements were translocated from the moribund leaves to the developing sprouts, which were very low in calcium content. These results agree with those of Truffaut in indicating that high calcium content is associated with senescence. The sprout crop uses its leaves to get rid of excess calcium. While calcium is necessary to maintain the pH of soil at a suitable level and to regulate uptake of other ions, large amounts of calcium do not appear to be needed in the plant and may, in fact, be harmful.

The ratio of "true" to crude protein showed a slight fall during the season, but the "organic" fraction of the phosphorus showed a steady, marked increase. This result does not confirm Greenhill and Page's suggestion that phosphorus may play an essential rôle in protein synthesis.

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MARKETING NOTES

Milk Marketing Scheme. The wholesale price for liquid milk (other than Tuberculin Tested milk) in April, 1938, was 1*s*. 4*d*. per gal., 1*d*. less than in the previous month, but the same as in April, 1937. The wholesale price for Tuberculin Tested milk in April, 1938, was 1*s*. 6*d*. per gal., 1*d*. less than in the previous month.

Pool Prices for April, 1938, are given below, with comparative figures for March, 1938, and April, 1937.

Region	*Pool Prices*		
	April 1938 *d*	*Mar.* 1938 *d*	*April* 1937 *d*
Northern	12½	13¾	12½
North-Western	12½	13¾	12½
Eastern ..	12¾	14	12¾
East Midland	12½	14	12½
West Midland	12¼	13½	12¼
North Wales	12¼	13¾	12¼
South Wales	12½	13¾	12½
Southern ..	12¾	14¼	12¾
Mid-Western	12	13½	12
Far-Western	12	13½	12
South-Eastern	13	14½	13
Unweighted Average	12·45	13·84	12·42

These prices are exclusive of any premium for special services and level deliveries, and also of the quality bonuses for Accredited and Tuberculin Tested milks. The estimated gallonage on which quality premiums have been earned was 38,763,554.

The inter-regional compensation levy was fixed at 2*d*. per gal., the same as in April, 1937. Sales on wholesale contracts were as follows:—

	April 1938 (*estimated*) *Gal*	*April* 1937 (*estimated*) *Gal.*
Liquid	50,916,681	47,764,718
Manufacturing .	30,893,466	25,043,243
	81,810,147	72,807,961
Percentage liquid sales	62·24	65·60
Percentage manufacturing sales	37·76	34·40

The average realization price of manufacturing milk during April was 6.56*d*. per gal., compared with 5.29*d*. per gal. for

April, 1937. The quantity of milk manufactured into cheese on farms was 1,639,449 gal., compared with 883,762 gal. in the previous month and 1,323,449 gal. in April, 1937.

Pigs Marketing Board. Mr. John A. Fox and Captain E. T. Morris have been re-elected Chairman and Vice-Chairman respectively of the Board.

Bacon Marketing Board. The Board has co-opted Mr. E. E. Marsh to take the place of the late Mr. A. E. Marsh as a member of the Board. The office of Chairman of the Bacon Marketing Board, which became vacant on the death of Mr. A. E. Marsh, has been filled by the appointment of Mr. J. F. Bodinnar, while Mr. H. Martin Lewis has been appointed Vice-Chairman.

Bacon Development Board. Mr. J. Kirkpatrick has been elected by the Bacon Marketing Board to fill the vacancy among the Board's representatives on the Bacon Development Board caused by the death of Mr. A. E. Marsh. Captain G. Deakin has been elected as a representative of the Pigs Marketing Board on the Bacon Development Board in place of Mr. R. Rowland.

Food Council and Consumers' Committees. Mr R. H. King of the Board of Trade has been appointed Secretary of the Food Council and of the Consumers' Committees for Great Britain and for England in place of Mr. J. R. Willis.

Milk Acts, 1934 to 1937: *Cheese-Milk and Butter-Milk prices.* For the purpose of payments under the Milk Acts in respect of milk used for manufacture, the Minister and the Secretary of State for Scotland have, with the approval of the Treasury, certified the following cheese-milk and butter-milk prices:—

Month	*Cheese-Milk Price Pence per gal.*	*Butter-Milk Price Pence per gal*
October, 1937 ..	6·40	5·55
November, 1937	6·59	6·23
December, 1937	6·76	6·17
January, 1938 ..	7·50	5·91
February, 1938	7·37	5·18
March, 1938	6·73	4·88

Wheat Act, 1932: *Sales of Home-Grown Wheat—Cereal Year* 1937-38. Certificates lodged with the Wheat Commission by registered growers during the period August 1, 1937, to May 6, 1938, cover sales of 20,249,382 cwt. of millable wheat as compared with 19,443,905½ cwt. in the corresponding period (to May 7) last year.

Sugar Industry (Reorganization) Act, 1936: *Results of the* 1937-38 *Campaign in Great Britain.* A comparative summary of the beet-sugar manufacturing campaigns 1936-37 and 1937-38 is given below:—

	1937–38	1936–37
Total acreage under sugar beet	313,917	355,421
Less acreage grown for seed .	933	511
Total net acreage grown under contract for delivery to factories	312,984	354,910
Tonnage of beet delivered to factories	2,582,808	3,448,008
Average yield of beet per acre (tons)	8·25	9·7
Average sugar content of beet (per cent.)	17·0	17·3
Average farm output of sucrose per acre of beet (lb.)	3,142	3,765
Average price paid per ton of beet delivered to factories	40*s.* 6*d.*	39*s.* 9*d.*
Total sum, including cost of transport, paid by factories to growers	£5,230,000	£6,853,000
Number of beet growers	38,538	40,303
Average acreage per grower	8·1	8·8
Number of factories .	18	18
Average number of days worked at factories	73	97
Average number of workers employed in the factories during the campaign	9,500	9,600
Production of sugar		
(i) of all polarizations (tons)	390,961	537,387
(ii) in white equivalent (tons)	377,133	521,963
Average extraction of sugar expressed as a percentage of the beet delivered to factories		
(i) all polarizations	15·1	15·6
(ii) white equivalent	14·6	15·1
Average factory output of manufactured sugar per acre:		
(i) all polarizations (lb.) .	2,798	3,392
(ii) white equivalent (lb.)	2,699	3,294
Average extraction of sugar expressed as a percentage of the total sucrose in the beet		
(i) all polarizations ..	89·0	90·1
(ii) white equivalent	85·9	87·5
Production of by-products		
Molasses (tons) .	85,170	110,641
Pulp: Dry (tons)	214,513	278,578
Wet (tons) .	59,558	83,967
Average extraction of molasses expressed as a percentage of the beet delivered to factories	3·3	3·2
Direct Exchequer assistance paid ..	(*a*) £1,231,810	(*b*) £2,562,113

(*a*) Includes a supplementary payment of £141,239 paid to growers on account of poverty of the crop of sugar-beet under Section 15 of the Sugar Industry (Reorganization) Act, 1936. The sum shown is subject to an addition, not yet determined, in respect of the balance of a claim under the Incentive Agreement for the British Sugar Corporation's share of economies achieved in 1936-37.

(*b*) After deduction of £13,990 in respect of adjustment of maximum quota income in accordance with para. 3 (iv) of the Fourth Schedule to the Sugar Industry (Reorganization) Act, 1936.

Potato Marketing Scheme: *Sale of "Seconds."* On May 6, the Potato Marketing Board announced that registered producers, on making application to the Board, would forthwith be granted permission to sell "seconds" for human consumption, "seconds" being defined as sound, marketable potatoes which are capable of passing through a riddle of 1¾ in. or less, but stand on a riddle of 1¼ in.

No "seconds" may be marketed unless special labels, to be supplied by the Board, are attached to the bags or other containers used.

Riddle Regulations. Subsequently, the Board also announced a change in the riddle regulations. As and from May 13 until further notice, the riddles in force throughout Great Britain are 1½ in. for the varieties Golden Wonder, Red King, King Edward and Gladstone, and 1⅝ in. for all other varieties.

Hops Marketing Scheme. At the Annual General Meeting of registered producers held on May 6, the four retiring special members of the Board were re-elected for a further year.

Livestock Industry Act, 1937: *Cattle Fund.* The table below gives particulars of the operation of the Cattle Fund under the Cattle Industry (Emergency Provisions) Acts, 1934 to 1936, and the Livestock Industry Act, 1937:—

	Payments	*Animals Covered by Payments*	*Average Payment per Animal*
	£		£ s. d.
April, 1936	316,021	133,837	2 7 2¼
" 1937 . . .	356,540	150,108	2 7 6
" 1938	308,272	109,725	2 16 2

Subsidy Payments. Under the revised scheme, which came into operation on August 1, 1937, subsidy is payable at the following rates:—

(1) 7*s* 6*d* per cwt. for a home-bred animal of quality standard;
(2) 5*s*. per cwt. for a home-bred animal of ordinary standard or for an imported animal of quality standard;
(3) 2*s*. 6*d*. per cwt. for an imported animal of ordinary standard.

The numbers and percentages of beasts certified under each category from the inception of the revised scheme to the end of March last are shown in the table below.

	Total No. of Cattle Certified	Home Bred		Imported	
		Ordinary Standard	Quality Standard	Ordinary Standard	Quality Standard
August, 1937–March, 1938					
England ..	670,198	295,394	190,877	89,914	95,013
,, (per cent)	*100*	*44·1*	*28·4*	*13·4*	*14·1*
Wales . ..	55,599	42,446	10,690	1,708	755
,, (per cent)	*100*	*76·3*	*19 2*	*3*	*1·5*
Scotland.. ..	212,941	30,879	109,127	9,469	63,466
,, (per cent)	*100*	*14·5*	*51·3*	*4·4*	*29·8*
N. Ireland ..	67,518	54,867	5,573	6,144	934
,, (per cent)	*100*	*81·5*	*8 2*	*9*	*1 3*
United Kingdom	1,006,256	423,586	316,267	106,235	160,168
,, (per cent)	*100*	*42·2*	*31·4*	*10·5*	*15·9*
March, 1938					
England	81,085	27,721	32,397	7,118	13,849
,, (per cent)	*100*	*34·3*	*40*	*8 7*	*17*
Wales . ..	5,033	3,383	1,539	49	62
,, (per cent.)	*100*	*67·5*	*30·5*	*1*	*1*
Scotland.. ..	31,063	2,852	16,484	887	10,840
,, (per cent)	*100*	*9·4*	*53*	*2·8*	*34·8*
N Ireland ..	9,361	7,416	1,268	513	164
,, (per cent.)	*100*	*79·3*	*13·5*	*5·5*	*1·7*
United Kingdom	126,542	41,372	51,688	8,567	24 915
,, (per cent.)	*100*	*32·6*	*40·8*	*7*	*19·6*

Approval Order under Section 14. The Livestock Commission, with the approval of the Minister, have made an Order under Section 14 of the Act approving the premises known as the Newton Abbot Cattle Market at Newton Abbot, Devonshire, for use as a livestock market. The market has recently been extended to include premises that were not used for the purposes of a livestock market during the year ended November 30, 1936.

Marketing Demonstrations. Particulars of the agricultural shows at which the Ministry is staging exhibits this year were given in the May issue of the JOURNAL. The first has already been staged at the Bath and West Show at Plymouth, May 25-28, and included an apple grading and packing demonstration that aroused considerable interest.

A very successful exhibition was concluded on May 7 at the Manchester Grocers' and Allied Trades Exhibition at Belle Vue, Manchester, and on May 5 a comprehensive display of National Mark produce was staged at Long Ashton for the Annual Cider Tasting Day.

Particulars of the exhibits and demonstrations arranged for June and early July are as follows:—

Show	*Demonstration*
ROYAL COUNTIES, Bournemouth June 1–4	Egg Grading and Tomato Grading Demonstrations Honey, Dairy and Egg Exhibits
THREE COUNTIES, Gloucester June 7–9	Egg Grading and Apple Grading Demonstrations. Dairy, Fruit, Egg and Asparagus Exhibits
LEICESTER, Leicester June 10–11	Egg Grading and Livestock Demonstrations Dairy and Egg Exhibits
ROYAL NORFOLK, Hunstanton June 15–16	Egg Grading and Apple Grading Demonstrations Honey, Fruit, Vegetable and Egg Exhibits
PETERBOROUGH June 28–30	Egg Grading Demonstration
ALDERSHOT June 30–July 2	Egg Grading Demonstration, National Mark Exhibit

JUNE ON THE FARM

R. W. Wheldon, D.Sc.,

King's College, Newcastle-on-Tyne

At the time of writing (May 14) there are signs that the long drought is likely to break. Some rain has fallen in certain areas, but the fall has not been uniform over the country, and in no case does there appear to have been enough.

The rainfall recorded at Cockle Park during 1938 is the lowest since recording commenced in 1898.

January had 2.35 in. of rain, but the total for February, March and April is only 1.55 in. while the forty years average for these three months is 5.5 in. In 1937 we had 9 54 in. during the three months referred to.

The experience of the present season brings home to us how dependent we are on climatic conditions, and how good cultural conditions and manuring assist the crop during an adverse period.

Grass Land. Pastures for the most part are burnt up and very closely eaten. On the breaking of the present drought, any new growth will afford pasturage of high quality rich in protein, and supplementary food of a carbohydrate type such as maize or other cereal food may be necessary.

Permanent, as well as temporary, hay ground has been grazed until the present time on many farms owing to the urgent need for keep. Although such closely grazed fields are very bare at present, it is probable that the hay crop from them may be better than anticipated, should favourable growing weather ensue. Ungrazed hay fields in most instances have made little growth, but the plants are coming to maturity and flowering stems are general. Such plants are less likely to respond to favourable growing conditions and may yield less than those which have been closely eaten.

Reference was made in these notes last month to the importance of quality in hay and the effect of management and manuring on quality. A recently issued report* on hay manurial trials carried out by Pawson and Murchie on meadow hay land on hill farms in Northumberland at

* Copies may be obtained from the Authors at King's College, Newcastle-on-Tyne

an altitude of from 700 to over 1,000 ft., gives some interesting results in this connexion. The object of the trial was to ascertain if the bulk yields obtained in manurial trials on lowland farms, e.g., the Palace Leas meadow hay trial at Cockle Park, could be obtained on hill farms in spite of differences in altitude and grazing management, and to investigate the effects on the quality of the hay when the bulk yield is increased by more intensive manuring. The trial, conducted at three centres, extended over three years and included duplicate plots, a comparison being made between nitrochalk, a concentrated complete fertilizer, basic slag with potash, and the usual dung dressing applied by the farmer.

The results in bulk yield of crop from the application of farmyard manure further confirm the value of this manure for meadow hay. The difficulty on most hill farms, and on many lowland farms, is the limited amount of dung available for meadow hay and, in consequence, much of the land is under-fertilized. The average crop of meadow hay for England and Wales is returned at one ton per acre, and the Palace Leas plots at Cockle Park give this as an average yield on the untreated plot, while approximately two tons are obtained by proper manurial treatment. The outstanding result in these trials is the marked increase in the bulk yield from an annual application of a complete manure; this treatment over three years has not resulted in any deterioration of the quality as judged by analysis for protein and mineral matter.

The nitrochalk treatment gave much more erratic results, the yields being influenced to a greater extent by previous manurial treatment. The trials confirm the view that nitrogen gives the best results when used with a sufficient backing of phosphates.

The slag and potash plot gave the same average increase in bulk as that obtained in the Palace Leas plots, namely, 8 cwt. per acre.

It is important to note that the meadows were all heavily grazed until the middle of May, and the complete fertilizer and nitrochalk were not applied until the fields were cleared of stock. The results are important in that they indicate that more hay can be economically produced on much of our hill land. The value of this lies not only in the fact that better provision is made for the sheep stock, but that a larger cattle stock can be carried.

No doubt the shortage of suitable winter keep is the chief cause for light cattle stocking on many of our high-lying, grass farms. More grazing cattle would, in many instances, greatly help the grazing for sheep. The advantages of mixed stocking on pastures of this type cannot be over-emphasized.

Cereals. Winter wheat, where the tilth was good, is standing well and looks promising, but there are many disappointing crops. Where the seed was sown under poor conditions in the autumn the crop is generally thin. Spring-sown wheat is making slow progress owing to the cold weather and lack of moisture. Unfortunately, the unfavourable conditions have persisted too long to allow much recovery when more favourable conditions arrive. One most striking feature of the season is the amount of damage by wireworms and leatherjackets. The damage seems to be out of all proportion to the number of larvae found, this being due, no doubt, to the slow growth of the plants and their inability to grow away or recover after attack.

Oats and barley are most variable. Early-sown crops are making slow growth and many yellow patches, due to frost and drought, are seen.

Roots. Where it has been possible to cultivate root land, the season has afforded a grand opportunity to clean land, and most of it has been sown in better condition in this respect than in most seasons. Germination has been slow, but if conditions improve the bulk of the crop will be ready to single at the same time, so that an early start is advisable.

Winter Keep. Although it is difficult to forecast the probable amount of winter keep, it is unlikely to be too abundant. To attain an average rainfall this year, an abnormal amount of rain must fall during the summer and autumn. This may mean a considerable growth of autumn grass, and the conservation of this to supplement winter keep is worthy of consideration. On most farms, silage would prove a most useful addition to the food supply, and any surplus pasturage later in the season may quite well be converted into this useful fodder. Either stack silage can be made or small silos, now obtainable at low cost, used. Should there be a reasonable prospect of grass for silage being available the advisability of using a

complete fertilizer to help the crop and maintain fertility might well be considered.

Where cereal crops have to be ploughed out owing to failure, the possiblility of sowing a silage mixture containing vetches might also be considered. Early June is not too late for a silage mixture, although the crop may not be quite so abundant as if sown earlier. A considerable amount of useful food may be obtained, and weather conditions are of rather less importance when silage is being made than for haymaking or harvesting.

The alternative to a silage crop is roots or bare fallow. It is quite easy to have too large an area of either on many farms, and the silage crop affords a way out.

Beans and Peas are not nearly such important farm crops to-day as when the farmer's choice of protein foods was more limited, and the quantity available less. Protein in these days is still an important consideration in the feeding of farm livestock, especially when we demand increased milk yields and higher live-weight increases in cattle, sheep and pigs. Beans and peas are valued by most feeders. There are comparatively few varieties to select from, probably because there has been little incentive given by the grower to the trade or the plant breeder to produce new and better varieties. With varieties of peas suitable for special purposes such as canning, etc., much useful work has been done to the advantage of the grower and consumer. It is possible that more consideration given to the requirements of these pulse crops as regards cultivation and manuring, as well as to the production of new varieties, may do something to give them a greater place amongst our farm crops. They can be handled by the normal labour of the farm and no extra or special machinery is required for dealing with them.

Sheep. In the north of England the clipping of lowland flocks takes place in the early part of the month and hill ewes are shorn towards the end. It is a busy time and the hill farmer ascertains the true numbers of lambs. Most of the reports to date are satisfactory. Fewer losses than usual have occurred at lambing time, but the bad weather in December probably accounted for fewer lambs being born on some farms.

Both lowland and hill farmers are familiar with losses of

young lambs, and occasionally ewes, which are apt to occur after a sudden flush of grass either in May or June. The onset of the disease is sudden, and death quickly ensues, and in consequence obviously affected animals are seldom seen alive. The disease is commonly known as "grass ill" or "pulpy kidney disease," the latter term referring to the pulpy and degenerated state of the kidneys—a prominent post-mortem change.

It was once thought that the trouble arose from the protein of the rapidly growing young herbage. This view is now known to be incorrect, and indeed there is no evidence that protein damages the kidney. The disease is caused by the multiplication of a micro-organism, *colostridium welshii* type D., in the intestines. This micro-organism elaborates a powerful poison that is absorbed into the general circulation and paralyses the vital centres in the brain, which accounts for the characteristic suddenness of death in this disease. The effort made by the kidneys to get rid of the poison results in irreparable damage to the structure. It is important to know that this disease is preventable, and prevention is most easily accomplished by the injection of the appropriate anti-serum shortly before the disease is expected to occur. The present season is one when such trouble may reasonably be anticipated, and flockmasters are advised to consult a veterinary surgeon with regard to this new and interesting work. In the north of England many farmers are finding this anti-serum most useful.

The season of growth also has an important influence upon animal parasites, and in June flockmasters and shepherds should watch carefully for signs of damage by intestinal worms. Worms should be suspected when there are signs of otherwise unaccountable unthriftiness.

NOTES ON FEEDING

CHARLES CROWTHER, M.A., Ph.D.,
Harper Adams Agricultural College

MILK SECRETION

When the food-supply of a growing or fattening animal is reduced to the maintenance level the increase of live-weight at once stops. In regard to milk-secretion, however, the effect of reduction of food-supply, though evident, is slower and less complete. On the other hand, whereas growth and fat production are resumed as soon as the food supply is raised again, this is by no means necessarily so with milk production, especially if the period of inadequate food supply has been prolonged. Clearly therefore the dependence of milk secretion upon food supply is less direct than that of the increase of tissue or fat. The explanation lies in the fact that in regard to the latter we are dealing with reactions of the whole animal organism, whereas in milk secretion we are concerned with the activity of a single organ, the milk (or mammary) gland.

In all glands the amount and composition of the glandular product is primarily determined by the physico-chemical status of the living cells of which the gland is composed. This applies particularly to glands where, as in the mammary gland, important constituents of the gland product are manufactured by chemical processes in the gland itself. There are various external factors that may raise or lower the volume of milk secreted, but the limit to which production can be raised at any given time is determined, both as to yield and quality, by the physiological condition at that time of the glandular cells. It is the fluctuations in this condition that mainly determine the variations found in the milk production of any individual animal at different stages of its life. Compared with this basic influence, all others, even that of food, are of only secondary importance. Although we must not underrate the importance of food in the "long term policy" of dairy herd management, it must be constantly remembered that by feeding alone, however abundant

and accurately " balanced " the food supply (and however capable the " management "), one can never turn an intrinsically poor milch cow into a good one. The milk-yielding potentialities of an individual are decided when its parents are mated. On the other hand, it is common knowledge how easily secondary factors, and especially incompetent feeding, may prevent the animal from developing these potentialities to the full.

Throughout its whole development and activity, the mammary gland is in intimate physiological association with the activities of the sexual organs. These in turn are regulated by the activities of other glands through the agency of chemical " messengers " (hormones) sent out by the latter from the stage of " puberty " onwards. The discovery of hormones and the elucidation of their functions is one of the most striking achievements of modern scientific research, but much remains to be done before a clear and complete picture can be obtained of the mechanism of their control of the activities of the female sexual organs, and the milk secretory activities therewith associated. This control is exercised throughout the whole period of development and functional activity of the sexual organs.

From the evidence now available there would appear to be at least three hormones concerned in the development of the mammary gland, each with a specific function and acting in a definite sequence.

First comes from the ovarian follicle a hormone (oestrone) which causes the development of ducts in the gland; then comes a second hormone (progesterone), also from the ovary, which promotes the growth of the secreting cells, or alveoli, of the milk gland; and thirdly a hormone (prolactin or galactin) from the pituitary gland (situated in the head) arouses the alveoli at the appropriate time to secretory activity. There is also evidence that the hormone, thyroxin, sent out from the thyroid gland, has a regulatory influence upon milk secretion, but this may trace back to pituitary control since the thyroid gland itself is subject to the action of another hormone (the " thyrotropic factor ") supplied to it from the pituitary gland.

Here may be interpolated a reference to the fact that the pituitary gland also secretes a hormone that controls body growth. Apparently the gland cannot provide both this and the sexual hormone at a maximum at the same time. At first

the production of the growth hormone predominates, and then as the rate of growth declines the development of the sex organs becomes more marked. These organs become functional, however, before body growth is completed, and if their ability to function is immediately utilized there may be an undue diversion of the pituitary secretions from body growth to sexual activity, with consequent unfavourable effect on body development. Herein doubtless lies in great part the explanation of the well-known risk to the completion of growth and development that is involved in premature breeding.

Reverting to the hormonal control of milk secretion, the pituitary and thyroid hormones are required not only for the initiation of the secretion process but also for its continuance. They are not primarily responsible, however, for the reduction in the volume of secretion that occurs with advance of lactation, this being due probably to a natural " working out " of the gland. The secreting cells which were built up during the previous pregnancy gradually cease to function and little or no new growth takes place. This process is speeded up when a new pregnancy supervenes to create competitive claims for the development of the new foetus.

It is a familiar observation that the milk yield tends as a rule to rise for a time after calving up to a peak at which it may remain for some time, and thereafter gradually falls The time involved in reaching the peak, and the amount of milk produced at this point, depend partly upon inherited factors, partly upon the " condition " of the cow prior to calving, and partly upon how she is fed and managed thereafter. During the period of rising yield the current nutrition of the cow is a matter of relatively secondary importance, since at that time the impulse to secrete is so strong that the animal readily draws on her body reserves for the purpose. This makes it desirable to bring her to good bodily condition (without being fat) before calving, since even then, no matter how she is fed after calving, she is almost certain to lose weight during the period of rising milk yield. It would seem desirable that during this period the food supply should be a little below rather than above the full requirements for maintenance and milk-yield, in order to avoid any element of forcing; and only when the peak has been attained should the full ration be provided. Only record-breaking aims can justify over-feeding in the stage of rising milk yield.

When the phase of declining milk-yield sets in there is a tendency for this decline to take a regular course, the drop each month being a fairly constant percentage of the yield of the previous month. The size of the percentage drop, which is the measure of " persistency," varies greatly with the individual and in different lactations. The onset of a new pregnancy will tend to accelerate the decline in milk-yield, but this effect is usually only small during the first 20 weeks or so after service. From this point onward this influence of pregnancy becomes the dominating factor in determining the duration of the lactation period, and usually ensures for the cow the desirable period of rest before another lactation commences. Many cows, however, unless artificially checked, will continue to secrete some milk right up to the next calving, so that there is clearly no established physiological mechanism for ensuring a rest period between lactations.

Underfeeding during the declining period of secretion has an immediate effect in lowering the output, but no system of feeding will entirely prevent the normal decline once it has set in.

With lactations of approximately equal length the milk output tends to increase for the first three to five lactations, during the earlier of which there is still some maternal growth to complete, and therefore, presumably, some diversion to this purpose of food that otherwise might have been applied to milk secretion. " Persistency," on the other hand, tends to decrease in succeeding lactations, if the rest periods between them are substantially equal, so that the higher total yields obtained in the later lactations must be due to a greater secretion during the earlier stages of the lactation, or, in other words, the level at which secretion begins tends to rise with increasing maturity. The longer the dry period, however, the greater tends to be the " persistency " in the next lactation, especially in the earlier lactation periods. Shortening the dry period before the second lactation will usually lower the yield far more than shortening it before a later lactation, since at the earlier stage there is more growth of body and of mammary gland to be secured during the rest period.

As to the actual mechanism by which milk is produced in the mammary gland our knowledge is very imperfect. Most of the organic constituents of the secretion are undoubtedly

manufactured in the gland, and are in fact not found elsewhere in nature. Other ingredients, such as the minerals, the less abundant proteins and the " amides," probably pass directly from the blood stream. At one time the view was held that the production of the former class involved the complete destruction of the secreting cells, the granules forming the lactose and fat, and the nuclei forming the protein of the milk. This view is no longer tenable in full, but some workers still maintain that there is a partial breakdown of the cells, whilst others prefer to regard the whole process as a true secretion.

Milk secretion appears to be a continuous process, (subject perhaps to a short pause immediately after milking), taking place most rapidly when the udder is empty, and slowing down as the milk accumulates and pressure in the udder increases. Only a small portion of the milk reaches the "cisterns " during the interval between milkings, the rest being held up in the alveoli and ducts. When the act of milking commences, the handling of the teats causes a stimulus to be imparted to the gland and the resulting increased pressure forces the milk down into the cisterns. The cow has " let down " her milk.

Apart from the very first runnings, which may include a small portion of " strippings " left undrawn at the previous milking, the milk tends to become steadily richer in fat as the milking proceeds. This phenomenon, along with the very large volume of milk often obtainable at a milking, has led to the view being widely held that milk secretion is divisible into two distinct phases—firstly, a relatively slow and steadily dwindling secretion of milk comparatively poor in fat during the intervals between milkings, and secondly, a rapid secretion of milk rich in fat during the act of milking, this second phase being initiated by the stimulus imparted to the teat. Evidence of doubtful accuracy as to the milk storage capacity of the cow's udder has been adduced in support of this view. Further confirmation seemed also to be afforded by the fact that the volume and composition of the milk obtained at a milking could be considerably influenced by the method of milking, more and richer milk being obtained by quick milking than by slow milking. The balance of evidence from more recent studies, however, is definitely adverse to this conception and seems to furnish an adequate explanation of the facts without assuming that the act

of milking is anything more than a removal of pre-formed milk from the udder.

Whatever the precise explanation may be, it is a simple fact that the way in which the act of milking is performed may exercise a considerable influence upon the volume and fat-content of the milk extracted from the udder. The prime requisite of efficient milking would appear to be the quickness with which the four quarters can be milked out, subject to the avoidance of undue disturbance of the cow. From this point of view, the milking machine, since it deals with all the quarters simultaneously, would seem to be the ideal, provided the complications due to the greatly varying volumes of milk obtainable from the separate quarters could be overcome, and provided also that it completes its task on the individual cow in no longer time than is required for efficient hand milking.

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Wheat, British ..	7 18	0 9	7 9	72	2 1	1·12	9·6
Barley, British Feeding	8 0§	0 9	7 11	71	2 2	1·16	6·2
,, Canadian No. 3 Western	7 15	0 9	7 6	71	2 1	1·12	6·2
,, Argentine ..	7 17	0 9	7 8	71	2 1	1·12	6·2
,, Australian	8 0§	0 9	7 11	71	2 2	1·16	6·2
,, Persian	7 5*	0 9	6 16	71	1 11	1·03	6·2
,, Russian	7 12*	0 9	7 3	71	2 0	1·07	6·2
Oats, English, white ..	8 7	0 10	7 17	60	2 7	1·38	7·6
,, ,, black and grey	8 7	0 10	7 17	60	2 7	1·38	7·6
,, Scotch, white ..	8 12	0 10	8 2	60	2 8	1·43	7·6
,, Canadian— No. 2 Western	10 10*	0 10	10 0	60	3 4	1·79	7·6
,, Mixed feed .	8 3	0 10	7 13	60	2 7	1·38	7·6
,, No. 1 feed	8 0§	0 10	7 10	60	2 6	1·34	7·6
Maize, American	7 7	0 7	7 0	78	1 10	0·98	7·6
,, Argentine	8 8	0 7	8 1	78	2 1	1·12	7 6
,, South African, No 2 White Flat . ..	7 3†	0 7	6 16	78	1 9	0 94	7·6
Beans, English, Winter	7 15§	0 18	6 17	66	2 1	1·12	19·7
Peas, English, blue .	12 2§	0 16	11 6	69	3 3	1·74	18·1
,, Japanese	19 0†	0 16	18 4	69	5 3	2·81	18·1
Dari .. .	7 18†	0 8	7 10	74	2 0	1·07	7·2
Milling Offals .—							
Bran, British	7 7	0 17	6 10	43	3 0	1·61	9 9
,, Broad	7 17	0 17	7 0	43	3 3	1·74	10·0
Middlings, fine, imported	7 10	0 14	6 16	69	2 0	1·07	12·1
Weatings‡ . ..	7 7	0 15	6 12	56	2 4	1·25	10·7
,, Superfine‡	7 15	0 14	7 1	69	2 1	1·12	12·1
Pollards, imported .	7 5	0 15	6 10	50	2 7	1·38	11·0
Meal, barley ..	8 17	0 9	8 8	71	2 4	1·25	6 2
,, ,, grade II	8 2	0 9	7 13	71	2 2	1·16	6 2
,, maize	7 17	0 7	7 10	78	1 11	1·03	7·6
,, ,, South African	7 2	0 7	6 15	78	1 9	0·94	7·6
,, ,, germ .	7 5	0 12	6 13	84	1 7	0·85	10·3
,, locust bean .	7 15	0 6	7 9	71	2 1	1·12	3·6
,, bean ..	9 7	0 18	8 9	66	2 7	1·38	19·7
,, fish (white) .	15 0	2 6	12 14	59	4 4	2·32	53·0
,, Soya bean (extracted)‡	8 12	1 12	7 0	64	2 2	1·16	38·3
Maize, cooked, flaked	8 7	0 7	8 0	84	1 11	1·03	9·2
Linseed cake—							
English, 12% oil .	10 12	1 2	9 10	74	2 7	1·38	24·6
,, 9% ,, .	10 0	1 2	8 18	74	2 5	1·29	24·6
,, 8% ,, ..	9 15	1 2	8 13	74	2 4	1·25	24·6

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv per 100 lb	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv
	£ s	£ s	£ s.		s d	d	%
Cottonseed cake—English, Egyptian seed, 4½% oil .	5 6	0 19	4 7	42	2 1	1·12	17·3
Cottonseed cake, Egyptian, 4½% oil .	4 17	0 19	3 18	42	1 10	0·98	17·3
Cottonseed cake, decorticated, 7–8% oil	7 15†	1 10	6 5	68	1 10	0·98	34·7
Cottonseed meal, decorticated, 7-8% oil	8 0†	1 10	6 10	70	1 10	0·98	36·8
Coconut cake, 5% oil	7 16†	0 19	6 17	77	1 9	0·94	16·4
Ground nut cake, 6–7% oil	7 0*	1 0	6 0	57	2 1	1·12	27·3
Ground nut cake, decorticated, 6-7% oil	8 2*	1 10	6 12	73	1 10	0·98	41·3
Ground nut cake, imported decorticated, 6-7% oil .	7 0	1 10	5 10	73	1 6	0 80	41·3
Palm-kernel cake, 4½–5½% oil ..	7 5†	0 13	6 12	73	1 10	0·98	16 9
Palm-kernel cake, meal, 4½% oil	7 10†	0 13	6 17	73	1 11	1·03	16 9
Palm-kernel meal, 1–2% oil .. .	6 17	0 13	6 4	71	1 9	0 94	16·5
Feeding treacle ..	5 0	0 9	4 11	51	1 9	0·94	2·7
Brewers' grains, dried ale	6 0	0 12	5 8	48	2 3	1·21	12·5
Brewers' grains, dried porter ..	5 12	0 12	5 0	48	2 1	1 12	12 5

* At Bristol. § At Hull. † At Liverpool.

‡ In these instances manurial value, starch equivalent and protein equivalent are provisional

NOTE. The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of April, 1938, and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative values of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, if linseed cake is offered locally at £11 per ton, then since its manurial value is £1 2*s* per ton as shown above, the cost of food value per ton is £9 18*s*. Dividing this figure by 74, the starch equivalent of linseed cake as given in the table, the cost per unit of starch equivalent is 2*s* 8*d*. Dividing this again by 22·4, the number of pounds of starch equivalent in one unit, the cost per lb. of starch equivalent is 1·43*d*. Similar calculations will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own markets. The figures given in the table under the heading manurial value per ton are calculated on the basis of the following unit prices N, 7*s* 9*d*, P_2O_5, 2*s* 7*d*., K_2O, 3*s*. 8*d*.

PRICES OF ARTIFICIAL MANURES

Description		Average prices per ton (2,240 lb.) during week ended May 18				
		Bristol	Hull	L'pool	London	Costs per Unit¶
		£ s	£ s	£ s	£ s	s d.
Nitrate of Soda (N 15½%) ..	*	8 0c	8 0c	8 0c	8 0c	10 4
,, ,, Granulated (N 16%)	*	8 0c	8 0c	8 0c	8 0c	10 0
Nitrate of Lime (N 13%) ..	*	7 7e	7 7e	7 7e	7 7e	11 4
Nitro-Chalk (N 15½%)	*	7 10c	7 10c	7 10c	7 10c	9 9
Sulphate of Ammonia:— Neutral (N 20·6%)	*	7 14c	7 14c	7 14c	7 14c	7 6
Calcium Cyanamide (N 20·6%)	*	7 16d	7 16d	7 16d	7 16d	7 7
Kainite (Pot 14%) .	§	2 18	2 15	2 15	2 15	3 11
Potash Salts (Pot 30%) ..	§	5 4	5 1	5 0	5 1	3 5
,, ,, (Pot 20%) .	§	3 15	3 12	3 12	3 12	3 7
Muriate of Potash (Pot 50%)	§	8 10	8 8	8 5	8 8	3 4
Sulphate ,, (Pot 48%)	§	10 2	10 0	9 17	10 0	4 2
Basic Slag (P A 15¾%) ..	§	2 12b	2 5b	—	2 10b	3 2
,, ,, (P A 14%) ..	§	2 8b	2 0b	2 0b	2 6b	3 3
Grd Rock Phosphate (P A 26-27½%)	§	3 7a	3 2a	2 18a	2 12a	2 0
Superphosphate (S P A 16%)	§	3 4	—	3 5f	3 2g	3 11
,, (S P A 13¾%)	§	3 1	2 17	3 2f	2 19g	4 3
Bone Meal (N 3¾%, P A 20½%)	§	—	7 5	7 0h	6 17	—
Steamed Bone Flour (N ¾%, P A 27½–29¾%)	§	5 5i	5 5	4 15h	4 10	—

Abbreviations N = Nitrogen ; P A. = Phosphoric Acid , S P A = Soluble Phosphoric Acid , Pot. = Potash.

* Prices are for not less than 6-ton lots, at purchaser's nearest railway station, unless otherwise stated Unit values are calculated on carriage-paid prices.

§ Prices are for not less than 2-ton lots, nett cash for prompt delivery f o r in town named, unless otherwise stated Unit values are calculated on f.o r. prices.

a Prices for 4-ton lots f o r Fineness 85% through standard sieve

b Prices for 6-ton lots Prices at Bristol are f o r Bridgwater , at Hull and Liverpool f o r neighbouring works, and at London f o r at depots in London district Fineness 80% through standard sieve

c For lots of 4 tons and under 6 tons the price is 1*s* per ton extra, for lots of 2 tons, and under 4 tons, 5*s* per ton extra and for lots of 1 ton and under 2 tons, 10*s* extra

d Delivered in 5-ton lots at purchaser's nearest railway station. For lots of 2 tons and under 5 tons the price is 5*s* per ton extra, for lots of 1 ton and under 2 tons, 10*s*. per ton extra and for lots of 4 cwt and under 1 ton, 20*s*. extra.

e For lots of 4 tons and under 6 tons the price is 1*s* per ton extra, for lots of 2 tons and under 4 tons, 5*s* per ton extra, for lots of 1 ton and under 2 tons 7*s* 6*d*. per ton extra, and for lots of under 1 ton, 20*s* extra

f Prices shown are f o r Widnes

g Prices shown are ex works London , f.o.r southern rails, 1*s* 3*d* extra

h Prices shown are f o r. Appley Bridge

i Price shown is f o.r. Newport, Mon.

¶ *These are calculated by regarding a ton as comprising 100 " units " (equal parts of 22·4 lb) so that a fertilizer, for example, with 16 per cent. nitrogen, contains 16 such " units " in a ton Then, if the price per ton of such a fertilizer be divided by the percentage figure, the deduced cost is that of a " unit " of that agent. Those in the table above are based on London prices. (For further explanation, see Advisory Leaflet, No 146, " The Valuation of Artificial Manures," obtainable from the Ministry, free of charge.)*

MISCELLANEOUS NOTES

The Agricultural Index Number, April, 1938

The general index number of prices of agricultural produce for April at 132 (base April, 1911-13=100) is 6 points higher than a month ago but 8 points below that recorded for the corresponding month last year. If allowance be made for payments under the Wheat Act, 1932, and the Livestock Industry Act, 1937, the revised index for the month becomes 137. Compared with March, average prices of fat cattle, bacon pigs, fowls, potatoes and meadow hay advanced, those of beans and eggs were unchanged, while other commodities used in compiling the general index were quoted lower.

Monthly index numbers of prices of Agricultural Produce (Corresponding months of 1911–13 = 100)

Month	1933	1934	1935	1936	1937	1938
January . ..	107	114	117	119	130	134
February .. .	106	112	115	118	129	130
March .	102	108	112	116	130	126
April ..	105	111	119	123	140	132
May . ..	102	112	111	115	133	—
June	100	110	111	116	131	—
July . ..	101	114	114	117	131	—
August	105	119	113	119	133	—
September . .	107	119	120	127	137	—
October .	107	114	113	125	131	—
November ..	109	114	113	125	133	—
December	110	113	114	126	132	—

Revised monthly index numbers of prices of Agricultural Produce, allowing for payments under the Wheat Act (a) and for the Cattle subsidy (b).

Month	1933	1934	1935	1936	1937	1938
January .	111	119	124	125	133	138
February ..	110	117	122	123	133	135
March	106	112	118	122	134	131
April . ..	109	116	126	128	143	137
May . ..	105	116	117	120	136	—
June .. .	104	114	117	121	134	—
July . .	104	117	120	121	134	—
August	108	122	120	124	136	—
September	111	125	128	133	142	—
October	112	121	119	129	134	—
November	113	120	119	129	137	—
December	114	120	120	130	136	—

(a) Commenced August, 1932. (b) Commenced September, 1934.

In the following table the monthly index numbers of prices of individual commodities are shown for the months of January, to April, 1938, April, 1937, and April, 1936; base, the corresponding months of 1911-13=100.

Commodity	1938				1937	1936
	Apr.	Mar	Feb.	Jan.	Apr.	Apr.
Wheat	100	104	109	114	131	85
Barley	146	153	156	165	132	96
Oats	113	119	119	124	119	85
Fat cattle	115	117	121	123	106	92
,, sheep	119	118	122	133	153	128
Bacon pigs	130	129	132	134	119	111
Pork ,,	132	133	135	140	117	112
Eggs	129	116	122	120	112	107
Poultry	118	136	130	133	113	115
Milk	215	171	181	181	215	215
Butter	111	105	105	105	104	96
Cheese	119	119	121	125	109	100
Potatoes	120	138	140	142	191	164
Hay	76	77	76	77	100	79
Wool	102	104	115	122	138	97
Dairy cows	117	120	123	123	112	100
Store cattle	119	123	123	119	109	94
,, sheep	105	99	102	113	128	109
,, pigs	145	143	151	164	126	122

Revised index numbers due to payments under the Wheat Act and to the Cattle subsidy.

Wheat	131	134	134	135	131	120
Fat cattle	129	132	136	138	120	106
General Index	137	131	135	138	143	128

Grain. Wheat at 7*s*. 7*d*. per cwt. averaged 2*d*. less on the month and the index declines by 4 points. If the deficiency payment under the Wheat Act, 1932, is taken into account the index is 131. Barley at 11*s*. 2*d*. and oats at 8*s*. per cwt. were reduced by 11*d*. and 5*d*. per cwt. respectively, as compared with March, and the relative indices fall by 7 and 6 points. In April, 1937, wheat averaged 9*s*. 11*d*., barley 10*s*. 1*d*. and oats 8*s*. 5*d*. per cwt.

Live Stock. The average price of second quality fat cattle rose by 10*d*. to 42*s*. 1*d*. per live cwt. but, with a greater rise occurring in the base price, the index moves downwards by 2 points. If the subsidy under the Livestock Industry Act, 1937, is added, the index becomes 129. Quotations for

second quality fat sheep were ½*d*. less at 9½*d*. per lb., but a proportionately larger reduction was recorded in the base period, and the index is 1 point higher. Prices of bacon pigs advanced by 1*d*. to 13*s*. per score (20 lb.) and the index appreciates by 1 point, but porkers, at 14*s*. per score, average 1*d*. less and the index is 1 point lower.

Dairy cows were cheaper than in March, the index receding by 3 points. Quotations for store cattle were slightly higher but, a more pronounced upward movement in prices having taken place during the corresponding months of 1911-13, the index is four points lower. Store sheep and pigs realized more money during the month under review and the indices advance by 6 and 2 points respectively.

Dairy and Poultry Produce. The contract price of liquid milk was reduced by 1*d*. per gallon; the rise of 44 points in the index, therefore, is due to the seasonal fall between March and April in the base period having been considerably greater than that between the corresponding two months of this year. Butter, at 1*s*. 2¾*d*. per lb., averaged ½*d*. less than in March but, here again, a larger fall occurred in the base years and the index moves upwards by 6 points. Eggs, at 9*s*. 9*d*. per 120, were unchanged in price but, with average prices in the months of April, 1911-13, showing a reduction, the current index appreciates by 13 points. Quotations for cheese were little altered and the index remains at 119. The combined index for poultry at 118 compares with 136 in March.

Other Commodities. At £5 9*s*. 6*d*. per ton, prices of potatoes were somewhat higher but, with a larger increase being recorded during the base period, the index falls by 18 points. Price movements of both clover and meadow hay were slight, the combined index for hay being 1 point lower. Wool at 1*s*. 1⅛*d*. per lb. was ¼*d*. cheaper and the index falls by 2 points

Imperial Conference on Agricultural Co-operation

The Imperial Conference on Agricultural Co-operation to be held at the Empire Exhibition in Glasgow on July 18-20, will be the first of its kind since the Conference held at the Wembley Exhibition in 1924. It has been organized by a Committee representing the National Farmers' Union and the Agricultural Organization Societies of Scotland, Wales and Ireland, and has the support of agricultural Departments. Support and representation have also been

promised from a number of overseas agricultural co-operative organizations.

There will be an inaugural address on the present position of agricultural co-operation by Dr. C. R. Fay, while further sessions will be devoted to discussions on the sale of agricultural requirements; on modern marketing problems, with special reference to milk, dairy produce and fruit; on co-operation and State control, including the experience of marketing boards and similar bodies; and on the relations between producers and consumers. As far as possible, speakers will be drawn from different parts of the British Commonwealth and will deal with problems on which they are experts.

One session will be reserved for the problems of particular commodities, and the discussion of these will take place in commodity groups formed from among the Conference delegates. There will be a special meeting in connexion with Young Farmers' Clubs. It is hoped that the days following the Conference may be devoted to excursions that will provide members with an opportunity of seeing something of the co-operative movement in Scotland and, possibly, other parts of the British Isles.

Enquiries should be addressed to the Secretary, Horace Plunkett Foundation, 10, Doughty Street, London, W.C.1.

Weeds

At this season of the year the necessity for weed eradication cannot be too strongly emphasized. The harm done by weeds to arable crops is of serious concern to farmers, market gardeners and small-holders. In pastures, meadows and grazing grounds their presence is not so apparent, but the injury they do is no less real.

Last year, owing largely to exceptional conditions, many reports were received of the prevalence of certain weeds, notably Ragwort.

Farmers, market gardeners, small-holders and other occupiers of agricultural land are urged in their own interests as well as in the national interests to make a special effort this year to destroy weeds, and to do so before *seeding* takes place.

Certain powers have been conferred on the Minister of Agriculture and Fisheries by the Schedule to the Corn Production Acts (Repeal) Act, 1921, to enforce the destruc-

tion of the particular weeds named in the Schedule, viz., Spear Thistle, Creeping or Field Thistle, Curled Dock, Broad-leaved Dock and Ragwort. These powers have been delegated to all County Agricultural Committees in England and Wales, including the Agricultural Committees of the County Boroughs of Birmingham, Huddersfield, Manchester, Rotherham, Southport and Wakefield, and any communication on the subject of putting the Act in operation as regards any particular land should be addressed to the Clerk of the Agricultural Committee at the offices of the Council for the County or County Borough in which the land is situated.

If, however, the land is situated in the County of London, or in a County Borough for which there is no Agricultural Committee, communications should be addressed to the Ministry.

Number of Fowls on Agricultural Holdings in United Kingdom in December, 1937

From information obtained by the Ministry, the Department of Agriculture for Scotland and the Ministry of Agriculture for Northern Ireland, the following estimates have been made of the number of fowls in the United Kingdom in December, 1937. The comparable figures for June, 1937, are also given and it should be noted that whereas the enumeration for England and Wales and Scotland relates to December 4 and June 4, 1937, that for Northern Ireland relates to January 1, 1938, and June 1, 1937.

Country	Date of Census 1937	Fowls over 6 Months	Fowls under 6 Months	Total of Fowls
England and Wales	Dec ..	29,538,000	6,625,000	36,163,000
	June ..	24,377,000	28,256,000	52,633,000
Scotland .. .	Dec. ..	4,313,000	674,000	4,987,000
	June ..	3,620,000	3,577,000	7,197,000
Northern Ireland	Dec. ..	(a)	(a)	5,792,000*
	June ..	(a)	(a)	9,222,000
United Kingdom ..	Dec. ..	—	—	46,942,000
	June ..	—	—	69,052,000

(a) Figures not available. * Comparable figure at January 1, 1937, was 6,111,000.

It will be observed that there is a seasonal reduction in the totals for the United Kingdom from 69 million head at the

beginning of June to nearly 47 million in December. This reduction is attributable to the fact that a large proportion of the spring hatchings, which come into the enumeration in June, are killed or die before the end of the year. The reduction is greater in the figures for Northern Ireland, due to the inclusion of the extra killings during the whole of December for the Christmas season's trade.

Ensilage

In the 3rd edition of the Ministry's bulletin on ensilage an account was given of the A.I.V. process. It was not possible at the time, however, to give much more than a brief description of the method, since it had not long been introduced into this country, and the evidence available here regarding the new process was too conflicting to permit of any definite recommendations being made.

A 4th edition of the Bulletin* has now been prepared, and the author, Dr. H. E. Woodman, of Cambridge, has been able to take advantage of the results of a number of fundamental investigations, not only of the A.I.V. process, but also of other methods that have as their object the controlling of the fermentation by the addition of accessory substances, such as crude sugar, whey and molasses, during filling of the silo. Account has also been taken of the modern developments in silo construction and of the great bulk of recent work dealing with the conservation of young grass of high protein content in the form of silage. The recognition of the special feeding qualities of young, leafy herbage has given a timely stimulus to the study of ensilage, and the results of research into this phase of the silage problem have profoundly influenced the trend of thought in this branch of agricultural science. The conservation of young grass as silage and its preservation by artificial drying are to be regarded as complementary and not antagonistic processes.

The further very extensive revision has resulted in a considerable enlargement of the Bulletin, which is now a complete guide to the modern practice of ensilage, and which should give all the information necessary to enable the farmer to decide for himself, in view of his circumstances, the merits or demerits of ensilage as a means of storing green crops in a succulent condition for use in the winter-feeding of live stock.

* Bulletin No 37, *Ensilage* Obtainable through a bookseller or from H M Stationery Office Price 1s (post free, 1s 2d)

Sampling Observations on Wheat, 1937-38: Report for Second Quarter

The quarter's observations cover the period of shoot formation and extend, roughly speaking, over the first three months of the year. The weather during the quarter was consistently mild, with no prolonged frosts. Rainfall was high in January, but below normal in February and lower still in March.

The observations are summarized in the Table, the stations being arranged in order of sowing date. Four sampling counts are made, at weekly intervals, of the numbers of shoots and plants. To obtain comparable results from station to station and from year to year, the date of tillering is defined conventionally as the date at which the number of shoots is twice the number of plants.

Reference to the table shows that the date of tillering is influenced, amongst other factors, both by the date of sowing and by the locality. At Wye, Plumpton, Newport, and Boghall, which were amongst the earliest stations to sow this season, the tillering dates are earlier than usual. At Wye, indeed, tillering took place at Christmas time, some two and a half months before the average date. On the other hand, at the stations which sowed late, tillering took place later than usual. The influence of sowing date on the progress of the crop, however, usually dies away as the season advances.

The influence of locality is also evident. Boghall (in Scotland) was the latest station to tiller, while Seale-Hayne, though late in sowing, was the second station to tiller and has in fact been first to tiller in all previous years.

As the Table shows, Yeoman usually tillers slightly before Squarehead's Master at most stations. This year, however, there was no consistent difference between the two varieties from place to place.

The rate at which tillers are produced is determined at least partly by the temperature during the period of shoot formation. Thus stations at which tillering takes place in March have usually higher tillering rates than stations which tiller early. The rate of formation of shoots varied this year from one shoot in 5 weeks at Plumpton to one shoot in 10 days at Rothamsted. The latter figure, which is exceptionally high, was no doubt affected by the phenomenally warm weather in early March.

Plant elimination between germination and tillering has been small in extent this year, presumably owing to the

SAMPLING OBSERVATIONS ON WHEAT, 1937–38 SECOND QUARTER

Station	Variety	Tillering: Date 1937–38	Tillering: Date Average 1933–37	Tillering: Rate (Tillers per 100 Plants per week) 1937–38	Tillering: Rate (Tillers per 100 Plants per week) Average 1933–37	Tillering: Density (Plant number per 32 metres) 1937–38	Tillering: Density (Plant number per 32 metres) Average 1933–37
Wye, Kent	S H M*	Dec 29 23	Mar 14·0	30·7	39·3	1,853	1,320
	Yeoman	Dec 25 37	Mar. 11 6	26·7	38·8	2,303	1,328
Plumpton, Sussex	S H M	Feb 14·69	Mar 14·0†	20·3	37·4†	1,197	640†
	Yeoman	Feb 16·45	Mar 14·4†	19·7	47·7†	1,177	694†
Cirencester, Gloucestershire	S H M	Before	Feb 16 1	—	22·3‡	2,166§	886‡
	Yeoman	Mar 3	Feb 14·1	—	23·0‡	2,371§	1115‡
	Little Joss		—	—	—	1,913§	—
Newport, Shropshire	S H M	Mar 4·21	Mar 19 2	26 5	49·7	369	624
	Yeoman	Mar 4 24	Mar 19·3	23·1	39·9	382	556
Boghall, Edinburgh	S H M	Mar 30·54	Apr 6 9	24·4	44·5	1,451	1,353
	Yeoman	Mar 31·70	Apr 5·8	32·5	44·6	1,615	1,439
Woburn, Bedfordshire	S H M	Mar 8·31	Feb 15·8	44·3	28·3	1,647	1,224
	Yeoman	Mar 8·17	Feb 15·4	46·3	33 0	1,500	1,249
Newton Abbot (Seale Hayne Coll.), Devonshire	S H M	Feb 12 91	Jan 14·8	30·3	27·7	1,389	1,522
	Yeoman	Feb 14·64	Jan 8·2	24·9	23·8	1,410	1,622
	Victor	Feb 15·46	—	25·0	—	1,427	—
Rothamsted, Hertfordshire	S H M	Mar 12·99	Mar 1·9	77·2	30·2	1,097	1,473
	Yeoman	Mar 12·44	Feb 22·3	69·6	24·4	1,049	1,600
	Victor	Mar 15·51	—	63·4	—	1,029	—
Sprowston, Norfolk	S H M	Mar 27·04	Mar 11·3	47·3	33·6	503	1,339
	Yeoman	Mar. 24·97	Mar 10·1	50·5	35·3	589	1,375

* = Squarehead's Master † = 1934–37. ‡ = 1934–36. § on March 3

absence of frosts, and plant numbers, which were rather low at the first count after germination, are now about the average for these experiments.

Thus far the growth of the crop continues to be normal. The effects of the drought and of the unseasonably cold weather in April will be seen in the next quarter's report. *Note*: Owing to a mistake in the plan, the plant numbers given in the first quarter's report for Plumpton (first count) were in error. The correct figures are: S.H.M. 1389, Yeoman 1457.

International Institute of Agriculture

At the General Assembly of the International Institute of Agriculture, which opened in Rome on May 23, Great Britain and Northern Ireland are represented by the following Delegation:—

The Earl of Feversham, Parliamentary Secretary to the Ministry of Agriculture and Fisheries (head of the Delegation);

Mr R. R. Enfield, Assistant Secretary, Ministry of Agriculture and Fisheries;

Mr. E F Nash, Economist, Ministry of Agriculture and Fisheries,

Mr C Weatherill, C B E, Deputy Secretary to the Department of Agriculture for Scotland,

Mr. J M Ramsay, O B E, Principal, Department of Agriculture for Scotland,

Mr D. A E Harkness, Assistant Secretary, Ministry of Agriculture for Northern Ireland.

The General Assembly is the governing body of the International Institute of Agriculture, and meets every two years. The Institute, whose headquarters are in Rome, is the principal international agency dealing with statistical, economic and other information of interest to agriculture. The regular publications include the *International Yearbook of Agricultural Statistics*, which gives detailed figures covering all the important agricultural commodities and nearly every country in the world; an annual economic commentary on this Yearbook entitled *The World Agricultural Situation*, and international yearbooks relating to forestry statistics, farm accountancy, statistics and agricultural legislation. In addition, the monthly *International Review of Agriculture*, comprising sections on Agricultural Economics and Sociology, Agricultural Statistics, Agricultural Science and Practice, and Plant Protection, summarizes the statistical information available month by month and contains articles on many topics of interest to agriculture, including crop forecasts and

estimates of world supplies and requirements. Information is also broadcast by the Institute from Rome.

Apart from these regular services, the Institute co-operated with the League of Nations in its recent study of nutrition, and has published many monographs on special subjects, some of the most recent being *International Trade in Meat, World Cotton Production and Trade,* and *International Trade in Agricultural Machinery.* The Institute also organized a *World Agricultural Census for* 1930, and has made arrangements for a similar census in 1940.

Potato Demonstration Plots

Demonstration plots of early varieties of potatoes—Arran Pilot, Arran Signet, Doon Early, Duke of York, Eclipse, May Queen, Ninetyfold and Sharpe's Express have been planted in eight counties. Field days are to be arranged when the crops are to be examined. Further particulars can be obtained from the local County Agricultural Organizer, or from the Potato Marketing Board, Africa House, Kingsway, W.C.2, or from the National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

The farms on which the plots have been arranged are:—

BEDFORDSHIRE, Mr. F. Inskip, Shefford Hardwick, Shefford.
CHESHIRE, Mr F Lomas, Sutton Hall, Sutton Weaver, nr. Warrington.
CORNWALL, Gulval Experimental Station, Gulval, Penzance.
HAMPSHIRE, Mr. T. Parker, Charity Farm, Fareham
ISLE OF ELY, Hickman & Co, Ltd, Leverington Hall, Leverington, Wisbech.
KENT, Mr. A. G. Batchelor, Galton's Farm, Cliffe, nr. Rochester.
LINCOLNSHIRE, Holland County Council Agricultural Institute, Kirton.
PEMBROKESHIRE, Mr J J. Belton, Gellyswick, Milford Haven.

FARM WORKERS' MINIMUM RATES OF WAGES

Agricultural Wages Board.—A meeting was held at Kings Buildings, Smith Square, London, S.W.1, on April 19, 1938.

The Board considered notifications from Agricultural Wages Committees of decisions fixing minimum and overtime rates of wages, and proceeded to make the following Orders:—

Cumberland and Westmorland. An Order fixing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers to come into operation on June 5, 1938 (i.e., the day following that on which the existing rates are due to expire) and to continue in force until May 27, 1939. The minimum rates are: (*a*) for male workers of 21 years of age and over hired by the month or longer period 42*s*. (instead of 41*s*) per week of customary hours (which is defined as meaning a week of 62 hours); (*b*) for other whole-time male workers

of similar age 34s. (instead of 33s.) per week of 48 hours in winter and 35s. 6d. (instead of 34s. 6d.) per week of 54 hours in summer, and (c) for casual male workers of 18 years of age and over 8¾d. per hour (instead of 8½d.) with overtime for all male workers of 18 years of age and over unchanged at 9d. per hour. The minimum rate for all female workers of 18 years of age and over is unchanged at 6d. per hour for all time worked.

Lancashire. An Order fixing minimum and overtime rates of wages came into operation on May 1, 1938 (i.e., the day following that on which the existing rates expired), and continues in force until April 30, 1939. The minimum rates in the case of male workers of 21 years of age and over are: In the Southern Area, workers employed wholly or mainly in one or more of the following capacities: Stockman, teamsman, poultryman, pigman or shepherd, 39s. (instead of 38s.) per week of 52½ hours, and other workers 35s. 6d. (instead of 34s. 6d.) per week of 50 hours; and in the remainder of the area of the Committee, workers of the special classes mentioned above, 42s. (instead of 41s.) and other workers 39s. 6d. (instead of 38s. 6d.) per week of 60 hours in each case. The overtime rates for all classes of adult male workers remain unchanged at 9d. per hour on weekdays and 1s. 1½d. per hour for employment (other than time necessarily spent in the immediate care of and attention to animals) on Sundays. Overtime at 9d. per hour is also payable for employment (other than immediate care of and attention to animals) on Good Friday. In the case of female workers of 18 years of age and over, the minimum rate remains unchanged at 6d. per hour for all time worked.

Staffordshire. An Order varying the existing minimum and overtime rates of wages, the rates as varied came into operation on April 24, 1938, and continue in force until further notice. The minimum rates in the case of male workers of 21 years of age and over are 35s. (instead of 34s.) per week of 44½ hours in the weeks in which Christmas Day and Good Friday fall and 54 hours in any other week, with overtime unchanged at 9d. per hour. The minimum rates in the case of female workers of 18 years of age and over remain unchanged at 5d. per hour with overtime at 6d. per hour.

Merioneth and Montgomery. An Order fixing minimum and overtime rates of wages for male workers and minimum rates of wages for female workers operates from May 1, 1938 (i.e., the day following that on which the existing rates expired) until April 30, 1939. The minimum rate in the case of male workers of 21 years of age and over employed wholly or mainly as stockmen, teamsters, carters, or shepherds is 35s. 6d. (instead of 35s.) per week of 58 hours; and the minimum rate for other male workers of 21 years of age and over is 31s. 6d. (instead of 31s.) per week of 52 hours with overtime in each case unchanged at 9d. per hour. In the case of female workers of 18 years of age and over the minimum rate remains unchanged at 5d. per hour for all time worked.

At a further meeting of the Board held on May 2, 1938, the following Orders were made:—

Northumberland. An Order fixing minimum and overtime rates of wages came into force at noon on May 13, 1938 (i.e., when the existing rates expired), and continues in operation until noon on May 13, 1939. The minimum rates for male workers of 21 years of age and over employed as shepherds are 44s. (instead of 39s. 6d.) in the case of workers who are householders and 41s. (instead of 36s. 6d.) in the case of workers who are not householders, per week of customary hours (not exceeding 62) and those for male workers of 21 years of age and over employed as stewards, horsemen, cattlemen or stockmen are 40s. 6d. (instead of 39s. 6d.) in

the case of workers who are householders, and 37*s*. 6*d*. (instead of 36*s*. 6*d*.) in the case of workers who are not householders, per week of customary hours (not exceeding 62). For other male workers of 21 years of age and over (except workers in casual employment) the minimum rate proposed is 33*s*. 6*d*. (instead of 32*s*. 6*d*.) per week of 48 hours in winter and 52½ hours in summer. Reduced weekly hours are fixed in respect of the weeks in which Christmas Day, Boxing Day, New Year's Day, Good Friday, Whit Monday and August Bank Holiday fall, or, if days are given in lieu of such holidays in the weeks in which such days in lieu fall. The overtime rates in the case of all regular adult male workers are 10*d* per hour on weekdays and 1*s*. per hour on Sundays (instead of 9*d*. and 11*d*. per hour respectively). The minimum rate for casual male workers of 18 years of age and over remains unchanged at 8*d*. per hour for all time worked The minimum rates for female workers of 18 years of age and over remain unchanged at 6*d*. per hour in the case of regular workers and 4*d* per hour in the case of casual workers in market gardens, with overtime at 7*d*. per hour and 5*d*. per hour respectively

Yorkshire (*East Riding*). An Order cancelling the existing minimum and overtime rates of wages and fixing fresh rates in substitution therefor came into force on May 30, 1938, and continues in operation until November 23, 1938. The minimum rate for all male workers of 21 years of age and over is unchanged at 35*s*. 6*d*. per week of 43 hours in the weeks in which Whit Monday and August Bank Holiday fall, and 52½ hours in any other week in summer (i.e, up to October 29, 1938) and 48 hours in any week in winter (i.e, the remainder of the period) The overtime rates of wages for male workers of 21 years of age and over are unchanged at 11*d*. per hour on weekdays and 1*s* 1*d*. per hour on Sundays, Whit Monday and August Bank Holiday The minimum rates of wages for female workers of 16 years of age and over remain unchanged at 6*d*. per hour with overtime at 9*d* per hour.

Enforcement of Minimum Rates of Wages.—During the month ending May 11, 1938, legal proceedings were taken against six employers for failure to pay the minimum rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases follow.—

Committee Area	Court	Fines Imposed	Costs Allowed	Arrears of Wages ordered	No of workers involved
		£ s d	£ s d	£ s d.	
Carmarthen	Llansawel ..	1 0 0	0 8 0	38 2 1	1
Derby ..	Chesterfield	(A)	3 5 6	42 8 2	2
Lancashire	Padiham ..	1 0 0	2 8 0	6 10 3	1
Pembroke ..	Haverford-west	(B)	—	—	1
Yorks (W.R)	Barnsley ..	10 0 0	0 10 0	40 18 5	1
Yorks (W.R)	Otley ..	2 0 0	2 12 0	7 7 9	1
	Totals ..	14 0 0	9 3 6	135 6 8	7

(A) = Dismissed on payment of costs.
(B) = Dismissed.

WIRELESS TALKS, JUNE, 1938

Station and Date	*Time p m.*	*Speaker*	*Subject*
National:			
June 1	6 20	Prof. J A Scott-Watson	Modern Grass Farming
,, 8	6 20	,, ,,	The Problem of Increasing the Home Output of Essential Foodstuffs
,, 15	6 20	,, ,,	Fenland Farming
,, 22	6 20	,, ,,	Not Yet Fixed
,, 29	6.20	,, ,,	The Danish National Agricultural Exhibition at Copenhagen
North:			
June 24	6 30	—	Lincolnshire Agricultural Show
Midland:			
June 7	9 45	Mr W B Thompson	Three Counties Show
West:			
June 2	6 40	Mr A W Ling	Cannington Farm Institute Trailer
,, 2	8 20	Discussion Principal W D Hay, members of the staff and students	Cannington Farm Institute
,, 3	9 00	Mr A N Symons	Guernsey Talk
,, 8	9 30	Messrs. A W Ling, G Scott, W Limbrick, S Gulliford, and S T Skelton	Federation of West Country Farmers
,, 16	6 40	Messrs A W Ling and L Ogilvie	Discussion
Welsh:			
June 3	7 30	Mr E J Roberts and others	Recent Experiments in Grass Drying
,, 17	7 30	Discussion	Town and Country (in Welsh)
Scottish:			
June 2	6 30	Mr A Fraser	For Scottish Farmers
,, 9	6 20	Mr J Anderson	Honey Production
,, 16	6 30	Mr A D Buchanan Smith	For Scottish Farmers
,, 22	6 45	Mr J R Allan	At the Highland Show
,, 23	6 40	,, ,,	,, ,,
Northern Ireland:			
June 6	9.40	Discussion: Dr G. Scott Robertson and others	Agriculture and the Consumer
,, 20	9.45	Mr P Fitzpatrick	Farmers' Work and Worry

University of Leeds Department of Agriculture.—Economics Section Farmers' Report No. 17: Some Economic Aspects of Poultry-keeping in Yorkshire. A Study on Nineteen Farms for the Year ending September 30, 1937, by *J. D. Nutt* (24 pp. mimeo.), 1938.

Agricultural Machinery

Smith, H. P.—Farm Machinery and Equipment. (2nd Edition.) (xiii + 460 pp) New York and London: McGraw-Hill Book Company, 1937, 18*s*.

Agricultural Research

Imperial Agricultural Bureaux Executive Council.—List of Agricultural Research Workers in the British Empire, 1937. (195 pp.) London · 1938, 5*s*.

Dairying and Dairy Products

Harvey, W. C., and Hill, H—Milk Products (viii + 387 pp) London: H. K. Lewis & Co., 1938, 21*s*.

Philpott, H C.—A History of the New Zealand Dairy Industry, 1840–1935. (413 pp. + 38 plates) Wellington: Government Printer, 1937.

The West of Scotland Agricultural College.—Research Bulletin No. 6: The Protein Supply for Dairy Cows, by *A. C. McCandlish.* (46 pp.). Glasgow, 1938.

Diseases of Animals and Veterinary Science

Southwell, T., and Kirshner, A—A Guide to Veterinary Parasitology for Veterinary Students and Practitioners (x + 143 pp) London · H. K. Lewis, 1938, 7*s*. 6*d*

Food, Nutrition, Preservation

Mottram, V. H., and Radloff, Ellen, M—Food Tables (63 pp) London. Edward Arnold & Co, 1937, 5*s*.

Department of Scientific and Industrial Research.—Food Investigation, Special Report No 46 Rancidity in Edible Fats (230 pp) London H.M. Stationery Office, 1938, 3*s* 6*d*

Fruit Culture and Horticulture

Pedersen, A. (Edit)—Danmarks Frugtsorter. (64 pp. + 16 plates.) Hefte I. Copenhagen: Alm. dansk Gartnerforening, 1938, *Kr.* 6.50. (Apples)

Hay, T.—Plants for the Connoisseur. (xi + 180 pp. + 1 plate) London · Putnam & Co., 1938, 10*s* 6*d*.

Live Stock, Breeding and Feeding

The Imperial Council of Agricultural Research, New Delhi—A Brief Survey of Some of the Important Breeds of Cattle in India, by *Col. Sir A Olver* (iii + 45 pp. + 52 plates + 1 map). Delhi · The Manager of Publications, 1938, *Rs.* 2 or 3*s* 6*d*.

Edmonds, J. L. et al.—Work Book in Producing Farm Livestock. (xi + 100 pp.) London Chapman & Hall, 1938, 5*s*.

Poultry

University of Bristol Department of Agriculture and Horticulture.—Bulletin No. 20: The Maintenance of Grassland for Poultry and the Value, Storage, and Utilisation of Poultry Manure, by *A. W. Ling* and *W R. Muir*. (23 pp.). Bristol, n.d.

Notices of Books

Soils

Johnson, G. W.—The Wasted Land. (vi + 110 pp.) University of North Carolina Press, 1937, $1.50.

Imperial Bureau of Pastures and Forage Crops.—Herbage Publication Series, Bulletin No. 25 Erosion and Soil Conservation, by *G. V. Jacks* and *R. O. Whyte*. (206 pp) Aberystwyth, 1938, 5*s*. (Also published as Technical Communication No 36 from the Imp. Bur Soil Sci.)

NOTICES OF BOOKS

The Village Carpenter. By Walter Rose. Pp. xxi + 146. (Cambridge University Press. Price 8*s*. 6*d*)

It is many years now since Mr. George Sturt in " The Wheelwright's Shop " gave his picture of village craftsmanship, and it is perhaps the highest tribute to Mr. Rose's book that it will bear comparison with that classic. What Mr. Sturt did for the wheelwright and Professor Okey for the basketmaker, Mr. Rose has done for the village carpenter. He has put him on record very definitely. For carpentry, as Mr. Kendon points out in an introduction that is a brilliant piece of sympathetic insight, is a gentle craft; wood is tender stuff, and carpenters seldom shout. That is why, as he says " There is a deep-rooted association of domestic modesty, frugality and wholesomeness about a carpenter's shop."

That sense of humanity, of kinship with nature, permeates the whole book. Here is the whole picture of the carpenter's life and work as the author knew it in his boyhood and youth—and what a life in its heyday ! " The kind of work that men sing at," for all the drudgery of the days before machines—which Mr. Rose welcomes to lighten the burden—yet inexhaustible in its variety and nourished by a pride of craftsmanship that the modern world has nearly forgotten and is seeking painfully to re-discover. The story is told with a simple directness that is completely befitting and that many a professional writer might copy. Mr. Rose is a master of vivid description and the pregnant phrase Here, for instance, is his description of the saw-pit as he recalled it from childhood —

> " the ceaseless up and down movement of the large shining saw wielded by two strong men at the pit; the slow creeping forward of the cut . . . yet ever advancing towards the toes of the man standing on the log—though he always moved them back just in time. . . We loved to go down into that pit. It was always moist and cool; there was a perpetual odour of sawdust, and large yellow frogs often peered out at us from chinks in its slab-lined walls "

Here are his meditations on the repair of old furniture :—

> " To take in hand a derelict piece covered with the grime of years and to clean and restore it almost to its original condition is as gracious as an act of charity."

Or again, describing his experiences as an undertaker, a task which he detested (" Nature did not fashion me for undertaking ") :—

> " I could not witness unmoved the children sobbing at the parent's grave or the broken-hearted mother at the grave of her first-born. I have seen a strong man cling desperately to the coffin of his child whilst I was waiting to screw on the lid."

The illustrations are as good as the text. The photograph opposite page 110 is a masterpiece.

Of the chapters describing the phases of the carpenter's work those on wind- and water-mills are particularly fascinating, while that on wooden

pumps records one of the highlights of the woodworker's craft—one which, though extinct in Mr. Rose's neighbourhood, fortunately survives elsewhere. Perhaps it is the background of the book that will make the greatest appeal to the general reader. Here is the very smell of the soil, a calling that deals with a product of the soil and that is dedicated to the service of land-users. Over the whole story there broods a sorrow for the decay of the countryside. The book spans the whole epoch of the English rural revolution, from the memories of the author's grandfather, the founder of the firm, driven off the land as a young man by the enclosures, to the inexorable nemesis of that wrongdoing that baffles our statesmanship to-day.

What of the future ? Mr. Rose dares to express hope. Not all will share his faith in the town immigrant as the means of rebuilding village life, but at all events the townsman brings money and sometimes an intelligent interest in his new surroundings. Here, as Mr. Rose perceives, is the village craftsman's opportunity, and for none more than the carpenter—but not for the second-rate tradesman, the rule-of-thumb man or the botcher. The village carpenter of to-day must study the principles of his craft; always he must be businesslike and be prepared to do a plain job simply, but he must have the knowledge and skill to seize his chance when it comes. Revolt against the machine spreads, but a new tradition has to be created, and there is a vast and hardly-begun work of education, among craftsmen and public alike, before handwork can recover its lost place in the community's life To all who care for the furtherance of that work this book will be a guide and inspiration.

Wood Preservation. By N. A. Richardson, B.Sc., A.I.C. Pp. iii + 13. (London · His Majesty's Stationery Office. 1937. Price 6*d*.)

The choice of a suitable preservative for wood presents certain difficulties. A chemical may prove ineffective when applied to certain types of timber. Some treatments are harmful to plant life, while others provide protection against fungi but not against ordinary weathering. This publication issued by the Department of Scientific and Industrial Research, describes various types of preservatives and deals with their appropriate uses, giving advice that should prove helpful to farmers and others who are concerned with the care and management of timber.

Agricultural Marketing in Northern India. By S. A. Husain. Pp. 342. (George Allen & Unwin. Price 15*s*.)

This book has a wider scope than its title suggests and it discusses a number of basic problems of Indian agriculture. The author's personal experience, however, relates chiefly to conditions in the north of the Empire.

India has 350 million inhabitants, 70 per cent. of whom depend on agriculture for a livelihood. The population is increasing, but the standard of living is already deplorably low and malnutrition is widespread. What is to be done ?

Mr. Husain starts from the axiom that the key to any general improvement in conditions is a policy not of intensive industrialization, or of self-sufficiency, but of agricultural reform. The obstacles, however, are appalling. Less than 8 per cent. of the village population are literate, and 70 per cent. are in constant debt. Methods and implements used in production are " as old as civilization itself." Seed, if not adulterated, is usually inferior. Livestock is very poor. Animal manure is largely consumed as fuel, and artificial fertilizers are little used. Holdings are scattered and subdivided. Irrigation, in spite of considerable progress, is still insufficient, and, it is suggested, too expensive.

In marketing, equally discouraging conditions prevail. Producers can rarely get credit for stored produce, even if storage facilities are available. Consequently, when repayment of credit advanced by money-lenders, dealers or co-operatives falls due immediately after harvest, the village markets are flooded with supplies and the bargaining position of producers is weakened. Further, trading arrangements in these markets, through which the bulk of the country's agricultural produce passes, are primitive, and the organized markets in the larger centres also suffer from such defects, as the multiplicity of commission charges, ill-defined trade practices, unstandardized weights and measures and unreliable weighing. Other handicaps from which marketing suffers are the lack of good roads, the systems of octroi and terminal taxes, and the absence of good wholesale warehousing arrangements.

Under these conditions, Mr. Husain urges that the first steps in agricultural reform should be the improvement of cultivation on lines already familiar from the recommendations of numerous official reports, and the removal of marketing disabilities; and that it would be inadvisable to establish large-scale marketing organizations, similar to those which have been adopted in western countries, where production and marketing are already fairly efficient

The key to the policy suggested appears to be the local co-operative. One would be needed in each village Besides furnishing production credit, which at present is often their only function, they would provide facilities for collective storage with financial assistance from the State, give credit on the security of produce stored with them, and act as agencies for the purchase of farm requisites Other recommendations are that weights and measures should be rigidly standardized and supervised; that efficient licensed warehouses should be established at the wholesale market centres; and that market arrangements should be regularized under an enabling statute which would permit all primary markets to be placed on a uniform basis. (A successful beginning on these lines has already been made under the Cotton Markets Act, 1927.)

The author criticizes the European trading community for opposition to certain reforms, notably wheat standardization; the jute manufacturers for lack of enterprise even when faced with the collapse of their industry, and the Government of India for lack of energy in introducing reforms and lack of sympathy with agriculture in the past. The appointment of a central and provincial marketing staff is welcomed, as is the creation of the Imperial Council of Agricultural Research, which co-ordinates the work of research stations and gives them advice and financial assistance. Both these changes had their origin in the report published in 1928 by the Royal Commission on Indian Agriculture, of which the present Viceroy was Chairman.

The book contains much useful information, is readably written and well indexed; but in some respects the arrangement might have been improved.

The Potato: Its Culture, Uses, History and Classification. 4th edition revised. By William Stuart, M.S, D.S. Pp. xv. + 508. (New York and London: J. B. Lippincott Co. 1937. Price 12*s.* 6*d.*)

In this new edition of a well-known work the statistical data have been revised. The chapters on potato breeding and classification have been extensively altered and improved. The book has become established as the standard book for university students in the United States of America and can be read with great interest and profit by potato enthusiasts in this country also.

British Grasses and Their Employment in Agriculture. By S. F. Armstrong, M.A. 3rd edition. Pp. ix + 350, and 194 Figs. (Cambridge University Press. 1937. Price 15*s*.)

The appearance of the third and much enlarged edition of Armstrong's standard work on British Grasses is singularly opportune. The book is now a complete treatise, not only on grasses, but on grass land, and it runs to 350 pages, compared with the 199 pages of the second edition (published in 1921).

The first and botanical section remains substantially as before, but Chapter II, dealing with the "General Biology of Grasses," has been slightly extended, even so, and having regard to the needs of the modern student, this chapter cannot be regarded as quite adequate. The chapter on "Botanical Description of Species" has been considerably improved by the addition of further and excellent illustrations, while references to literature are now given at the foot of each chapter respectively, and it may be incidentally remarked that the author has quoted copiously and judiciously, and thus greatly to the benefit of the student reader.

The Agricultural Section has been completely remodelled and re-written, and greatly amplified, it now constitutes a just and lucid exposition on the present state of knowledge relative to grasses and grass land. The value of this section is much enhanced by numerous and excellent photographs The treatment of the various grasses is perhaps a little uneven; thus, less than a page is devoted to *Agrostis tenuis*, although this grass (the common bent) probably contributes a greater area to our British grass lands than any other single species Sweet vernal grass, of no very great importance in this country, is dealt with more exhaustively.

In the chapter on "Seeds Mixtures" more weight should perhaps be given to the precise management that will be adopted as influencing the choice of species and strains, the question of strain as such is, however, treated in detail A useful little chapter on "Lawns and Greens" is added.

This edition should immediately replace the earlier editions on the shelves of all who are interested in grass land, and it is a book that will admirably fill a real need, both on the part of agricultural students and of practical farmers, while all teachers of agriculture will feel grateful to Mr Armstrong for the manner in which he has covered what has now become not only a large and involved but also a vital subject.

The Law Relating to Tithes. By P. W. Millard, LL.D.Lond. Pp. xli + 423 + li (London Butterworth & Co. 1937. Price 15*s*.)

This publication, which is the third edition of the author's book on the law relating to Tithes and payments in lieu thereof, follows on the passing of the Tithe Act, 1936. According to its title this Act was passed to extinguish tithe rentcharge and extraordinary tithe rentcharge, but the author has included in the present edition detailed explanations of the old law relating to the commutation of tithes, and to tithe rentcharge as necessary for a proper understanding of existing legislation. In consequence considerable portions of the present work are of historical rather than present-day interest.

As already indicated, the main provisions of the Act of 1936 embody a scheme for the extinguishment of tithe rentcharge payable under the Tithe Acts, 1836 to 1925, and extraordinary tithe rentcharge payable under the Extraordinary Tithe Acts, 1886 and 1897. As from October 2, 1936, the State purchased from the owners of tithe rentcharge and extra-

ordinary tithe rentcharge their interests in that property and are in process of recompensing them by the issue of 3 per cent. Government guaranteed stock, which will be redeemable at par in 60 years, supplemented, as regards ecclesiastical tithe rentcharge, by certain cash payments. The acquisition was for the purpose of extinguishment of tithe rentcharge and extraordinary tithe rentcharge as then existing, and the half-yearly instalment of tithe rentcharge and extraordinary tithe rentcharge due and payable on October 1, 1936, was, therefore, the last payment of such rentcharges to the titheowners In consideration of the extinguishment, and in order to provide the necessary funds for the payment of interest on the stock and the creation of a sinking fund to redeem it, the landowners whose property was subject to tithe rentcharge and extraordinary tithe rentcharge became liable to pay to the State redemption annuities payable half-yearly for a period of 60 years, the first half-yearly instalment becoming due and payable on April 1, 1937. The duty of administering the Act was entrusted to a Tithe Redemption Commission

It will be readily understood that such a scheme necessitated legislation of a very wide character, embracing such matters as rating, taxation, liability for repairs to chancels, and remissions of tithe redemption annuities in certain circumstances The detail with which this somewhat intricate legislation with all its ramifications is treated in the book under review, should render it of special value to members of the legal profession as well as to those directly concerned with the management of land, although some may regret that, owing to considerations of space, the author found it impossible to make the work self-contained by including the text of the relevant Statutes, an omission which is not entirely remedied by annotations referring to Halsbury's Statutes There is a copious index.

A Textbook of Plant Virus Diseases. By Kenneth Smith Pp x + 615. 101 figs. (London . J & A. Churchill, Ltd , 1937. Price 21*s*)

This very complete and well-illustrated compilation of the known plant virus diseases will satisfy a definite need that has been increasingly felt lately by those who are working on plant pathology During the last twenty years advances in our knowledge of virus diseases have been very rapid, and contributions have been made by research workers in all parts of the world. The result has been that important research work is to be found in journals published in every continent and in several different languages Dr Kenneth Smith has collected together and systematized this mass of information, so that the known facts about any virus disease can be quickly ascertained Well selected bibliographies at the end of each chapter permit rapid reference to original sources A detailed chapter on the insects concerned in the transmission of plant viruses is included at the end, as well as an appendix summarizing the main symptoms characteristic of the various diseases on each host plant

The title of the book is certainly rather misleading, for there is no general discussion of viruses or the diseases they cause, such as one would expect to find in a " text-book." The book is essentially a reference encyclopedia of the plant virus diseases, and, as such, fulfils its purpose admirably.

This is not the place to discuss in detail the technical aspects of the work, but mention should be made of the fact that the book sets out to provide a complete indexing system for all the known viruses. The

system adopted is essentially that proposed by Dr. James Johnson, of Wisconsin, U.S.A., although in designating the viruses Dr. Kenneth Smith has used the scientific names of the host plants in preference to the common names. In applying the system, however, he has completely changed the order of the numbers assigned by Prof. Johnson, for reasons that are in many instances not very obvious. To give one example, Johnson's Potato Viruses 1, 3, 8, 11, 16 and 20 become Kenneth Smith's Solanum Viruses 14, 9, 12, 15, 1 and 2 respectively! Prof. Johnson's proposed classification was not published, but was presented to an International Committee on Description and Nomenclature of Plant Viruses, appointed by the last two International Botanical Conferences. It was also circulated privately to a number of virus workers. The fact that Dr. Kenneth Smith in his book mentions some of Prof. Johnson's numbers as synonyms of his own numbers, but not others, may therefore be somewhat confusing. The changes in numbers are also the more to be regretted since Prof. Johnson is still at work endeavouring to improve the system which he originally proposed.

The above numbers for the viruses may perhaps appear a little alarming to the non-specialist, but they are intended mainly for purposes of convenient arrangement and reference. It is unlikely that the familiar popular names of the diseases caused by the viruses will be soon discarded. The name Potato Leaf-roll, for example, still stands, but the disease is now caused by Solanum Virus 14, according to Kenneth Smith, instead of by the Potato Leaf-roll Virus, as used to be said in the good old days. That we are not expected to abandon our old ways too suddenly, however, is obvious from the appendix, where the viruses in the key are referred to in the customary manner, the new names with numbers being given in brackets.

In a work of this size there are bound to be some points open to technical criticism. The statement, for example, that in England strawberry yellow-edge virus is almost invariably accompanied by crinkle virus is certainly in error. Such mistakes, however, are not frequent, and misprints are agreeably few, although some are surprising. The strawberry variety, Tardive de Leopold, is set down as Jardine de Leopold, but possibly this paragraph was written during a Test Match! It is also rather surprising to find, in a work of a serious kind, the variety Madame Lefebvre referred to so familiarly as Lefebre. One almost expects on a following page to find it reduced to the still more familiar Phoebe, but this did not occur! These, however, are minor faults in a book that assembles a vast amount of information about plant virus diseases, and that will certainly prove an indispensable reference work for professional plant pathologists.

Index to the Literature of Food Investigation, Vol. VII, No. 1. Compiled by A. E. Glennie, B.Sc., and G. Davies, B.A. Pp. xii + 371. (London: His Majesty's Stationery Office. 1937. Price 5s.)

This index consists of abstracts of the principal literature on the subject of food investigation published in 1934. During the next twelve months it is hoped to issue further volumes covering the years 1935 and 1936, while an index of papers published during 1937 is in active preparation. The present number is preceded by a comprehensive review of developments during 1933–34 dealing with the gas-storage of rice and eggs, antioxidants for fats and oils, and refrigerated transport, in the last section mention being made of the circumstance that 1934 marked the centenary of the earliest continuous refrigerating machine.

Notices of Books

Marketing Poultry Products. By E. W. Benjamin, Ph.D., and H. C. Pierce, B.S.A. 3rd edition. Pp. xi + 401, & 212 Figs. (London: Chapman & Hall, Ltd. 1937. Price 20s.)

This volume is an encyclopædic study embracing all aspects of the egg and poultry trade, and ranging from details of production and rearing to the finer points of poultry advertising and retail display. The numerous aspects of the trade treated by the authors enable the reader to realize the rapid growth of the poultry industry and to appreciate some of its "growing pains." Perhaps one might have wished that the authors had dwelt at little more length on the subject of egg quality in the opening chapters. This field of investigation is becoming of increasing importance, and one in which American workers have covered much ground, and it is therefore doubly disappointing that the results of experimental work should be recounted without many conclusions being drawn or possibilities suggested by the authors.

British readers will be particularly interested in the grading and packing of both eggs and poultry in America. No doubt the more extensive country with its distant collecting points make grading and packing a matter of as much importance as it is to the countries despatching to us.

The concluding chapters indicate the extension of grading and packing methods, and the standardization attempted by the Government. The authors state that the services of U.S. inspectors and graders for grading at terminal points are increasingly in demand. This increasing interest of the large American firms in the advantages accruing from grading is mentioned on many occasions, and it is a significant comment on the situation that the co-authors, once members of scientific and government departments, are now retained by commercial firms.

Can Industry Govern Itself? An Account of Ten Directed Economies. By O. W. Willcox. Pp. 285. (London George Allen & Unwin, Ltd. 1936. Price 10s.)

Mr. Willcox gives a very readable account of the post-war vicissitudes of the world sugar industry, and of the measures adopted in ten countries for the protection and regulation of the national industry when the period of rising prices that shortly followed the war was succeeded by one of general overproduction of sugar and a consequent collapse in world prices. The book may be commended to any reader who wishes to get a bird's-eye view of the world conditions that led up to the Chadbourne Agreement, or to appreciate the conditions that prevailed in some of the principal sugar-producing countries when the International Sugar Conference met in 1937.

Mr. Willcox's main object is, however, to establish that a market for a basic commodity may exist in one or other of two totally dissimilar phases—a phase of unsaturation in which demand outruns supply, and a phase of supersaturation, in which supply outruns demand While he considers that the former phase is the proper sphere of economic liberalism, it is in his view both right and necessary that in a period of supersaturation individualism should be subordinated to a social economic scheme of "proration," by which we understand a scheme for preserving existing social and economic values by a scheme of rationalization. If at this point the reader is unable to follow the author in his criticism of the "predacity" of the "economic man," it will at least be recognized that he has entered a notable plea in favour of a directed economy in times of market supersaturation, the implications of which extend far beyond the sugar industry, to which the book is mainly directed.

NOTICES OF BOOKS

The Dairy Industry in Canada. By J. A. Ruddick and Others. Edited by H. A. Innis. Pp. xxxii + 299. (London: Humphrey Milford. 1937. Price 17*s.*)

This volume has been planned to describe the background of the dairy industry in Canada as it relates to international trade in general and trade with the United States in particular; to give a general survey of the industry; to describe its problems generally and in relation to a specific region, and to suggest the effects of tariff policy.

The history of the industry in Canada from the seventeenth century to the present day is dealt with in considerable detail. We read that "indirect aid in the form of annual grants of money has been given to the dairy industry by provincial governments ever since there has been any organization among the dairymen competent to administer such funds." Again, at the end of last century the Dominion Government gave considerable financial aid to the development of refrigeration and cold storage, with especial reference to the dairy industry; and, in 1907, a Cold Storage Act was passed for extending this development.

Milk production in Canada is estimated to have increased from about 700 million gallons in 1900 to 1,600 million gallons in 1933 It will come as a surprise to many British readers to learn that "income from milk products considerably exceeded that from wheat both in 1933 and 1934 . . . Dairying has long assumed a leading position in several provinces, and promises to assume a leading position in the Dominion"

Political considerations inevitably predominate in the more important sections of the book, special attention being given to the discussion of Canadian reactions to the more recent tariff policies pursued by the United States At the present day the Canadian home market absorbs the major part of all the home farm produce, cheese being the sole Dominion dairy product of which more than half the total production is exported It is interesting to note that a Canadian Dairy Farmers' Federation was formed in 1934, and applied to the Government to set up a Dairy Produce Board, under the Natural Products Marketing Act, this Act was, however, invalidated in 1936 by a Supreme Court decision

The volume forms part of a series dealing with the relations of Canada and the United States. Clear, logical and well-documented, it will interest students of international affairs rather than students of agriculture or dairying in the more technical sense.

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NOTES FOR THE MONTH

Danish Agricultural Exhibition

During June Denmark has been celebrating the 150th anniversary of the Agricultural Reforms of 1788, which were brought about largely through the instrumentality of Count Christian Reventlow, ancestor of His Excellency the present Danish Minister in London, and under which the peasants acquired their independence. Under the traditional system that had previously obtained, the peasants had been tied to the big estates upon which the old open-field system of cultivation was practically universal. The reforms of 1788 encouraged enclosure and enabled the peasants eventually to become independent smallholders. At the present day, more than 50 per cent. of Danish holdings are under 25 acres, and it is significant that the remarkable development of Danish agriculture, particularly during the last 70 or 80 years, should have been carried through by a farming population consisting in the main of smallholders. The part played by co-operation in this development, associated as it has been with an admirable system of rural education has often been told. It is a story of which Denmark can rightfully be proud.

The exhibition commemorating these events took place at Bellahoj, near Copenhagen, from June 17 to 26. The site was admirably chosen on high ground with a view of Copenhagen in the distance, and the layout was contrived so as to preserve the natural attractiveness of the site and without requiring the elaborate buildings which have become the feature of modern exhibitions. All departments of Denmark's agriculture were adequately represented. The historical side naturally received due prominence, exhibiting a typical Danish four-wing farmhouse of the 1780 period, and a country smithy of the early 19th century. Near to these historical exhibits and in contrast with them were the modern allotments

and a typical Danish smallholding. This latter will probably be recalled by many foreign visitors as one of the most interesting features of the exhibition: the holding was shown complete with its buildings and land, and equipped with all the requisite implements and machinery.

As would be expected, the exhibits of live stock, totalling over 2,000, were impressive, and mention should also be made of the animal husbandry section in which the scientific side of animal production was given special emphasis. The Ministry was represented at this exhibition by Mr. Ramsbottom, M.P., and three members of the technical staff.

East Malling Research Station

Faced with the necessity of securing further accommodation to relieve the growing congestion of their workers, and having in mind the importance of being able to extend their experimental orchards on adjacent and suitable land in order to safeguard future developments, the Director and the Committee of Management of the East Malling Research Station have been very fortunate in being able to secure on reasonable terms the estate of the late Sir John Twisden, Bart., of Bradbourne, which adjoins the existing property of the Station. Those who are familiar with the district and remember the developments which, to the detriment of agriculture, are taking place on one side of the Station, will realize that this expansion of the East Malling Station in the direction of Bradbourne is the only avenue now open that permits of an extension of the Station's premises. The park and farm land of the Bradbourne estate, which comprise some 200 acres, will provide for the normal expansion of the research requirements of the Station in the future, a safeguard which is the more necessary because the industrial developments that are taking place at the other side of the Station's premises may make it desirable to carry out some reorganization of the existing layout of the experimental grounds.

The house, which has been acquired with the land, will accommodate the administrative offices, the library, the Imperial Bureau of Horticulture and Plantation Crops, and provide accommodation for a museum and facilities for conferences. Built about 1713, and incorporating even earlier premises, the building, a fine example of a Queen Anne period residence, is of historic interest. Its preservation has the support of the National Trust, the Pilgrim Trust, the Council

Photograph by East Malling Research Station

Bradbourne the West and South Fronts

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for the Preservation of Rural England, the Society for the Protection of Ancient Buildings and the Kent Archaeological Society.

A Treasury grant on a £ for £ basis has been sanctioned. In a public appeal that has recently been issued, however, it is pointed out that there remains to be found by private subscription a sum of at least £15,000 to provide for the acquisition and renovation of the property. Towards this amount, £3,750 has already been promised, including a generous grant of £2,500 from the Pilgrim Trust. Contributions would therefore be welcomed from any who are interested either in the work of the Station or in its newly acquired historic setting. They should be addressed to the Secretary, East Malling Research Station, near Maidstone, Kent.

In a future issue of this JOURNAL, Dr. R. G. Hatton, the Director of the East Malling Station will contribute a survey of the results of the experimental work carried out at the Station during the last few years.

Tar Distillate Washes

(Miscible Oil Type)

Fruit-growers and insecticide makers will be aware that negotiations have been in progress for some time between the Association of British Insecticide Manufacturers and the Ministry regarding the possibility of standardizing miscible tar distillate washes. Owing to the very complex nature of these washes, the question is by no means a simple one, and problems of considerable difficulty are involved. It is satisfactory to report, therefore, that definite progress has now been made and that provisional agreement has been come to on the main points of a specification for a miscible tar oil wash such as is in general use. An essential part of a specification is, however, that standard analytical methods should be prescribed by which it would be at any time possible to decide whether a given wash is in conformity with the specification. The elaboration of analytical methods is in itself as complex as the preparation of a satisfactory specification of the content, and in this direction a number of details still remain to be settled. Further analytical research will therefore be necessary and may occupy some months. In the meantime, in order to secure the greatest measure of standardization possible at the present time, manufacturers representing substantially the

total production of these washes* have given the Ministry a guarantee that all standard miscible (black) tar oil washes to be distributed during the coming season will be made according to the provisional specification. The Ministry is satisfied that under normal conditions such washes will prove effective if correctly diluted and properly applied.

Particulars of the specification can be provided on request, but it must be clearly understood that the present agreement with the manufacturers is of a temporary and provisional nature only and that as soon as the work now in progress permits, standard analytical methods will be incorporated in the specification and the whole will be published in the same manner as the specifications of the various insecticides and fungicides already dealt with in Bulletin No. 82.

Growers should understand that this announcement refers only to washes of the miscible oil (black) type and does not concern stock emulsions (mayonnaise) type. The agreement that has been reached in regard to miscible oil washes has no relation to the relative values of the black type and the stock emulsion washes and, in fact, it is proposed to deal with the latter in a similar manner as soon as possible.

Colorado Beetle

There is an increasing danger of the Colorado Beetle reaching this country by flight or other means in consequence of the further spread of the pest on the Continent, where the greater part of France and a large area of Belgium are now infested; outbreaks have also occurred in Germany, Luxemburg, Switzerland and Holland.

The success of measures undertaken for the eradication of the pest should it arrive here will depend on their being carried out in good time. The Ministry is accordingly anxious to obtain as early notification as possible of the discovery of the pest in this country. Potato growers, including private gardeners and allotment holders, particularly those in coastal districts, are asked to keep a close watch on their crops throughout the present season and to inform the Ministry as soon as they discover or suspect the presence of the Beetle, a full description of which is given in the Ministry's Advisory Leaflet No. 71. A single outbreak in a private kitchen garden, allotment, or potato field, which escapes detection may result

* A list of the firms will be supplied by the Ministry on request.

in a more widespread outbreak which might prove extremely difficult to eradicate.

Any yellowish beetle with black stripes, or any red or reddish-yellow grub, that is found feeding upon potato leaves should be regarded with suspicion. When suspected Colorado Beetles or grubs are discovered, specimens should be placed in a tin box (in which no holes should be punched) with a piece of potato leaf, and the box should be sent to the Ministry of Agriculture, 10, Whitehall Place, London, S.W.1,* with a letter stating the exact place where the insects were caught and the name and address of the finder. No other steps should be taken until instructions are received from the Ministry; it is especially important that the crop should not be sprayed, except under the authority of the Ministry, or be interfered with in any way, as unauthorized spraying or treatment may cause the beetles to spread, and an outbreak possibly affecting only two or three square yards may be distributed throughout the field, or even beyond it. Apart from the specimens sent to the Ministry, no beetles or grubs should be removed.

The object of these measures is to keep the insect confined to as small an area as possible, so that it may be eradicated without loss of time.

A summary of the provisions of the Importation of Plants (Amendment) Order of 1938, which came into force on June 13, 1938, imposing restrictions on the importation of certain kinds of horticultural produce from Switzerland appears on p. 404 of this JOURNAL.

Oats and Barley Subsidy—Qualifying Acreages in 1937

During the last few weeks payment of the Oats and Barley Subsidy sanctioned under Part II of the Agriculture Act, 1937, has been proceeding. The extent of the acreages that qualify for this subsidy, together with a brief survey of the situation are given in the following note.

An Order was made on April 29 determining the average price of oats in the United Kingdom for the purposes of the Oats and Barley Subsidy Scheme to have been *7s. 7d.* per cwt. in the seven months ended March 31, 1938. On this basis subsidy at the rate of *2s. 6d.* per acre is payable for

* Residents in Scotland should address letters and specimens to the Department of Agriculture for Scotland, 29, St. Andrew Square, Edinburgh 2.

both oats and barley—the rate for barley is determined by the price of oats—and practically the whole of the payments in respect of approved applications has now been made. In order to determine this average price it was necessary to compute the total acreage of oats qualifying for subsidy in England and Wales, Scotland and Northern Ireland, respectively, since under the provisions of the Act the average price of oats in each part of the United Kingdom has to be weighted by the qualifying acreage of oats in that part, in order to determine the general average price of oats for the United Kingdom as a whole.

The combined qualifying acreage of barley and oats for the whole of the United Kingdom amounts to approximately 1,300,000 acres and the following table shows the distribution of this total as between barley and oats in the different parts of the country:—

ACREAGE OF BARLEY AND OATS IN THE UNITED KINGDOM IN 1937 QUALIFYING FOR SUBSIDY UNDER PART II OF THE AGRICULTURE ACT, 1937

	Barley	Oats	Total
	Acres	Acres	Acres
England and Wales ..	106,100	322,600	428,700
Scotland	41,400	632,700	674,100
Northern Ireland	1,600	206,100	207,700
United Kingdom	149,100	1,161,400	1,310,500

A few applications are still the subject of correspondence, but there is no reason to anticipate that the final figures will differ to any appreciable extent from those given above. Under the provisions of the Act, mixed corn containing either barley or oats (or both) is eligible for subsidy on the basis of the percentage of the seeds mixture represented by barley or oats, and the appropriate acres have been included in the foregoing figures to cover the subsidy payable in respect of mixed corn. Ignoring this aspect, however, it is of interest to note that while, in England and Wales, the qualifying area represents only 13 per cent. of the barley and 26 per cent. of the oats returned on June 4, 1937, the corresponding percentages in Scotland are 51 and 77 per cent., and in Northern Ireland about 58 and 80 per cent. respectively. The smaller percentages in England and Wales are due to the importance of wheat growing in England and to the fact that a farmer

cannot obtain oats and barley subsidy as well as wheat deficiency payments. In consequence, in the great majority of cases in England, Wheat Deficiency Payments are of greater benefit to the farmer than the Oats and Barley Subsidy.

Of the total of 428,700 acres in England and Wales, about 303,000 acres represent applications from English counties, this total comprising 83,600 acres of barley and 219,400 acres of oats. The largest individual county total, namely, 47,000 acres, occurs in Cornwall, this being closely followed by Devon (44,000 acres) and then by Cumberland (37,000 acres). Norfolk with 26,000 acres comes fourth in order of importance, while the only other county totals exceeding 10,000 acres are Northumberland (16,000 acres), Lancashire (15,000 acres) and the North Riding of Yorkshire (14,000 acres). Practically two-thirds of the total qualifying acreage in England, is, therefore, to be found in these seven counties.

The largest areas in Wales occur in Cardigan (25,000 acres), and Pembroke (24,000 acres) while Carmarthen and Denbigh each have about 13,500 acres.

Progress of Land Fertility Scheme

The number of applications for contribution under the Land Fertility Scheme received from occupiers of agricultural land in the United Kingdom now exceeds 193,000. The quantities of lime and basic slag in respect of which these applications have been made are approximately 1,189,000 tons of lime and 395,000 tons of basic slag.

The Ministers concerned have determined that the maximum prices in respect of basic slag supplied under the Land Fertility Scheme for the year ending May 31, 1939, shall be the prices ruling on May 1, 1937 (i.e., before the Scheme came into force) less the following reductions:—

On grades up to and including 12 per cent. of P_2O_5—eightpence per ton;

On grades above 12 per cent. up to and including 15¾ per cent of P_2O_5—one shilling and sixpence per ton,

On grades over 15¾ per cent. of P_2O_5—two shillings and sixpence per ton.

Farm Crop Variety Trials

· A cordial invitation to visit the National Institute of Agricultural Botany during the summer months is extended to all who are interested in agriculture. Farmers who want to

satisfy themselves that they are growing the most profitable varieties of cereals, root crops, etc., should inspect the accurate field trials carried out by the Institute at Cambridge and at its sub-Stations at Askham Bryan (Yorks), Cannington (Somerset), Long Sutton (Hants), Newport (Salop) and at Sprowston (Norfolk). Farmers who are situated near any one of these sub-Stations may find it more convenient to visit them rather than Cambridge. The relative merits of the varieties included in the trials and observation plots may be discussed with members of the staff. July is the best month; visitors are welcome either singly or in parties, but arrangements should be made beforehand by writing to the Secretary, N.I.A.B., Huntingdon Road, Cambridge.

Dairy Research

The Agricultural Research Council, in a report recently published, surveys recent progress in dairy research.* The report deals with the programmes of research of the two National Institutes for research in dairying in England and Scotland, at Shinfield, near Reading, and at Kirkhill, near Ayr, and the work relating to dairy research carried out by the Division of Bacteriology and Immunology of the London School of Hygiene and Tropical Medicine, by the Glasgow and Edinburgh Colleges of Agriculture, and in the laboratories of United Dairies, Ltd. The problems under investigation at these centres are numerous; reference can only be made to a few of the directions in which important advances are being made.

The report records the urgent need for more knowledge concerning the physiology of lactation, and about the influence of hormones and their relation to milk quality, and indicates that the way is being prepared for an attack on this subject. The possibility of reducing present-day food protein standards for milk production is being tested in co-operation with many farmers.

Experiments have been carried out in Great Britain on the control of diseases, such as bovine tuberculosis, contagious abortion and mastitis, by approved methods of diagnosis and treatment. The Hannah Dairy Research Institute in Scotland

* Agricultural Research Council Special Reports No 3. H.M. Stationery Office. Price 2s., postage extra.

showed from an experiment which lasted four years, that 20 out of 30 herds which were under control had been cleared of tuberculosis. This demonstration led to the voluntary spread of the eradication movement on a remarkable scale.

Of particular interest are the results reported from three separate centres of experiments designed to ascertain the relative value of raw and pasteurized milk for calves. Confirmatory results were obtained by each centre working independently and showed no significant differences in the effect of the two types of milk, either on growth rate or on the condition of the calves at the end of the experiment. But in post-mortem examination none of the calves fed on pasteurized milk showed tuberculosis lesions, while lesions were found in 65 per cent. of those fed on raw milk. A method called the Phosphatase Test, has been evolved by workers at the Shinfield Institute for determining the efficiency of the process of pasteurization, and this has proved a valuable aid in the supervision of pasteurizing machinery. Work on the nutritive value of processed milks in comparison with that of the raw milk is now in progress at the Institute.

New knowledge is being gained about the factors governing the production of desirable market qualities in milk products, such as body, flavour and keeping qualities in cheese, butter and cream, and about the best methods of manufacturing dried milk and canned milk products. Since milk in itself is such a favourable medium for the growth and multiplication of bacteria, the study of the organisms which it contains and of the part which each group plays must naturally receive much attention. Bacteriologists at all centres of research are, therefore, engaged in studying the different types of bacteria and determining their source of origin. Not all organisms are harmful; some are beneficial as, for example, the lactic acid bacteria which are responsible for good flavour in cheese.

A chapter of the Report is devoted to the scientific work which influenced the framing of the recently revised Milk Designations Order, and another chapter gives an interesting account of the work of advisory dairy bacteriologists, who assist farmers and others interested in facing the problems of bacterial infection and the improvement of farm hygiene.

Studley College, Warwickshire

For some years past Studley College, Warwickshire, has been handicapped in that its premises, though historic and picturesque, did not provide adequate accommodation to permit of the development which the popularity of the College and the requirements of an up-to-date scientific education demanded. It is satisfactory to record that suitable new buildings have now been erected, which were opened by H.R.H. the Duchess of Gloucester on June 30.

The extensions comprise a new south wing designed to provide four laboratories for the teaching of bacteriology, biology, chemistry and physics; fifty study bedrooms for students, and a well-planned sick-bay. Considerable improvements have also been effected by a remodelling of the main building, which, although erected one hundred years ago, has nevertheless been successfully adapted to modern requirements. These developments, together with re-equipment and furnishing and very considerable improvements recently undertaken to the farm buildings, the horticultural, dairy, and poultry departments, have been carried through with the aid of a grant from the Development Fund, on a £ for £ basis, and the Governors of the College have been materially assisted by generous donations and contributions from friends and supporters of the College and from its past and present students. It is understood, however, that a considerable sum is still required to free the buildings from debt and to enable the College to consolidate and extend its work in the training of women for agriculture and horticulture.

THE KENT CHERRY ORCHARDS: THEIR MANAGEMENT AND CROPS

N. B. BAGENAL,
Technical Assistant, East Malling Research Station

Readers of Chaucer's *Canterbury Tales* will be familiar with that part of Watling Street which runs from Dover up through Canterbury, Faversham, Sittingbourne and on to Rochester, Dartford, Greenwich and London. Travellers to and from the Continent travelled along this road in the Middle Ages on horseback, and any who were expert in such matters would have had no difficulty in spying out the richness of the land on either side of the road as they passed through the famous brickearth area from Faversham to Sittingbourne and on to Gillingham. Some 400 years ago, Henry VIII's fruiterer passed this way on a journey to Flanders to fetch choice kinds of fruit trees for his royal master, and as he passed through Teynham, he must have made up his mind as to the best place to plant cherries, for the historians tell us that some 100 acres were planted in that parish by orders of King Henry VIII in the year 1533. The verdict of posterity has certainly upheld the judgment of the King's fruiterer. According to the agricultural returns for 1936, the six parishes containing the largest acreage of cherries in Kent were all within ten miles of Teynham and totalled between them over 1,800 acres of cherry orchards. This district, known to cherry growers as the Sittingbourne area is for the most part situated on brickearth soils. These overlie the chalk, and are usually deep loams of medium texture, containing a sufficiently large percentage of clay and silt particles to secure retention of moisture in dry weather. In general they have excellent natural drainage, and there is little fear of waterlogging in the winter—a condition which cherry trees are quite unable to endure. The brickearths of the Sittingbourne area are very deep, and this depth, combined with the perfect drainage are

no doubt largely responsible for the remarkable growth made by cherry trees in that district. For in spite of the very general belief that cherry trees are surface rooting, there is every reason to suppose that the largest cherry trees are grown in the deepest soils. Unfortunately for the cherry-growing industry in Kent, these brickearth deposits have been and still are much sought after by brickmakers, with the result that in many places the soil has been dug out to a depth of 6 or 8 ft. and cherries have then been planted at the lower level.

For further confirmation of the special suitability of brickearth loams for cherries it may be added that in the fruit soil surveys of the Lower Greensand and of the Hastings Beds some of the best cherry orchards were found on the Langley and Ladham series respectively, both of which are described as being true brickearth loams. The brickearth soils in the Stour valley between Ashford and Canterbury have some good cherry orchards, and cherries are also grown on well-drained soils of the Woolwich Beds and Thanet Sands in the north-west and north-east of the county, and in some of the deep and better-drained pockets of clay-with-flints overlying the chalk on the northern slope of the North Downs.

Enough has been said to indicate that cherry orchards are to be found widely distributed through the county, and it is a remarkable fact that fruitgrowers on their own accord appear to have picked out the brickearth areas on which to plant their cherries.

Varieties. The two most widely grown varieties of sweet cherry grown in Kent at the present time are Napoleon and Early Rivers. In the absence of any reliable statistics, the distribution of other varieties can only be guessed at, but it is probable that Amber Heart (or Kentish Bigarreau), Roundel, Governor Wood and Waterloo would make up the first six. This gives three black and three white varieties, an interesting point because most cherry buyers maintain that, apart from Napoleon, black cherries sell better than white. The reason for this is not obvious. It is possible that the average consumer actually prefers eating a black cherry to a white one, and is therefore willing to pay more for it, or again, it may be that the blacks sell more freely than the whites because there are not so many of them on the market. Most cherry growers would probably agree that, on the whole, the white cherry varieties commonly grown crop more heavily

Photograph by East Malling Research Station

A Typical Cherry Orchard in Kent

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than the black, with the possible exception in certain years of Early Rivers. Other things being equal, a variety that gives large regular crops of a medium quality cherry is in the long run more paying to grow than an unreliable cropping variety of a high quality cherry. One of the chief reasons for this is that the picking of cherries is an expensive and laborious affair, involving comparatively large gangs of pickers and a good deal of moving about of heavy and unwieldy ladders. Hence the common phrase so often hurled by growers at some shy cropper in a bad year: "That tree's not worth putting a ladder in," meaning that by the time the whole costly process has been gone through of placing the ladders in position, and sending the pickers up to pick a cherry here and there on each branch, the expenses involved have eaten up any possible profit. To put a concrete case, a grower might argue thus: "It pays me better to grow ten 'halves'* per tree of Amber at 5*s*. a half, costing me 1*s*. 2*d*. a half to pick, than five halves per tree of Noble at 8*s*. a half, costing me 1*s*. 6*d*. a half to pick."

The following are brief notes on some of the most popular varieties of cherry grown in Kent at the present time:—

BLACK CHERRIES

EARLY RIVERS.† Makes a very large tree and should be planted at least 40 ft apart on good cherry soil. The chief difficulty is to find a suitable pollinator which flowers early enough. Governor Wood, Nutberry Black, Frogmore, Noir de Guben have all been used as pollinators for Rivers with varying degrees of success. Specially valuable for early districts, and seems to grow fairly well even in soils which would not suit most varieties.

ROUNDEL. This large mid-season variety is very popular on the market, makes an upright tree and is being widely planted.

WATERLOO. Not such a popular variety to plant now as it used to be, although still reckoned by many the best flavoured cherry of all. It seems to require specially favourable conditions, being an uncertain cropper with many.

BRADBOURNE BLACK or GÉANT D'HEDELFINGEN. A large black bumpy cherry, one of the latest to pick. If it were not for its susceptibility to bacterial canker, this variety would be much more widely planted than it is at present.

* A "half" or half-sieve wicker basket holds 24 lb. net weight of cherries.

† The names given to cherry varieties in this article are those by which they are generally called in Kent. In the present state of uncertainty as to the true nomenclature of many varieties there can be no finality in the matter.

NOBLE. Used to be widely grown as Tradescant's Heart. One of the largest and best quality late cherries but unfortunately a very unreliable variety, and is no longer widely planted.

BIGARREAU GAUCHER. A large mid-season cherry which has been rapidly gaining in popularity of recent years and is now much sought after for planting.

Other black cherries that are grown to a less extent but which have good points of their own are Black Circassian, Werder's Black, Black Eagle, Malling Black Eagle, Victoria Black, Goodnestone Black, Nutberry Black, Turkey Heart (Turk), Webb's Black and the Caroon type.

WHITE CHERRIES

BIGARREAU NAPOLEON Perhaps the most popular of all cherries grown in Kent. Growers like it for its heavy regular cropping; buyers like it for its large size, firm flesh and brilliant colouring, but perhaps the chief reason for its popularity with growers and buyers is the fact that the public ask for it by name It flowers rather late in the spring and needs a pollinator with a similar blossoming period Its chief fault, and that a grave one, is a distinct susceptibility both to Silver-Leaf and to Bacterial Canker. In spite of this there seems no immediate likelihood that growers will stop planting Napoleon, and this in itself may constitute a grave risk in regard to the spread of Bacterial Canker.

AMBER (KENTISH BIGARREAU) At one time the most widely grown cherry in Kent, making a fine big tree and giving heavy regular crops in mid-July Is now winning fresh laurels as a canning and glacé cherry.

GOVERNOR WOOD An American variety which has been planted very widely in the past all over Kent, especially on early land It comes into cropping early in life, makes a curious umbrella-shaped tree, and is a remarkably regular bearer The fruit is rather small and soft and needs picking before it turns colour Very susceptible to Brown Rot and Cherry Leaf Scorch but is still planted in spite of these faults

FLORENCE. A very handsome, large, late cherry resembling Napoleon in appearance but a darker crimson Has a very distinct habit of growth with one or two "cordon"-like branches sticking nearly straight up in the air. Like most late cherries it is apt to crack badly if rain comes in July

FROGMORE. Many good cherry growers say this is their most paying cherry because of its heavy regular cropping It bridges the gap between the early and main crop varieties and ripens just after Governor Wood. Fruit is small and soon goes soft or "honey-hearted"

EMPEROR FRANCIS A very beautiful large late cherry, but one that splits badly and for that reason is not very popular.

EARLY AMBER. A very useful cherry for early land. Makes a smallish drooping tree. Fruit soft but early. Not widely planted.

OHIO BEAUTY. A great favourite with some growers on account of its extreme lateness and regular cropping. Not widely planted at present. Experts disagree as to the nomenclature of this variety.

BIGARREAU DE MEZEL. A French variety, ripening in early July, which has been attracting the attention of growers at the Kent Cherry and Soft Fruit Show in recent years. This Show, organized by the Kent Farmers' Union, has now been running since 1924. It has done much to popularize the best varieties of Kent cherries amongst the consuming public, and at the same time has had a widespread influence on the production side.

Management. In tracing the history of cherry growing in Kent, it is important to note the close connexion between cherries, hops and sheep. Cherries always used to be planted in hops whenever possible, and when the hops were grubbed, the land was sown down to grass, which would then become pasture for grazing flocks of sheep. Thus there grew up the tradition of " high-farming " for cherries, and that tradition has been the secret of successful cherry growing. Nothing was too good for hops, cherries or sheep, so that all farming practice was centred round these. This meant an extraordinary attention to detail. As young trees among the hops, the cherries received the best cultivations, shared in the high nitrogen manuring of the hops, had the best staking and tying that could be given, and as a result they got a really good start in life. Later, when grassed down, they lost the prestige of the hops, but gained the companionship of those famous flocks of Romney Marsh sheep which were the pride of their owners. When sheep farming was a paying proposition, it was no uncommon thing to stock the orchards with sheep at the rate of 5 to the acre in winter, and 10 to the acre in summer. This meant heavy artificial feeding with hay and roots in winter, cake and corn in spring and summer. For such sheep, nothing but the best grazing was good enough, and all the arts of grass management were employed to bring clovers, to make the grass palatable to the sheep, and so to make it capable of carrying large flocks. Such treatment naturally reacted favourably on the trees. Close and even grazing meant that sheep droppings were scattered evenly all over the orchard, and that the grass, in summer, was short and fine, thus reducing loss of moisture by evaporation.

Moreover, in the days when fattening of bullocks was a profitable farming practice most tenant farmers were bound by their lease to consume all hay and straw on the farm. This meant that in those magnificent bullock yards which still adorn so many farmsteads in the north of Kent a very large quantity of the best farmyard manure was made yearly, and any surplus not needed for the hop garden was available for spreading round the cherry trees in established orchards.

In this way balance was maintained throughout the life of the cherry trees. Vigorous growth in the early years under conditions of clean cultivation and high nitrogen manuring, was followed by a slowing down of growth with the growing of the grass. This encouraged the trees to come into

bearing, and by the time they were in full bearing, the manuring was being done thoroughly. In addition to the organic nitrogenous manure applied by the sheep and by the farmyard manure, phosphates were often applied in the form of bonemeal, and potash in the form of kainit.

To-day, the tradition of high farming for cherries still holds as strongly as ever, but economic changes have been making themselves felt for some time, and in many respects orchard management has had to be modified to meet changing conditions. With the restriction of the hop acreage, the practice of planting cherries in hops has largely been given up. For the most part growers still prefer to plant the trees in arable and to grow roots or small fruits for the first years before grassing down, but there are other equally experienced growers who now plant in grass, digging round each tree for the first few years and keeping the ground well mulched round the roots.

One or two bold heretics have even advanced the theory that, with the advent of the disc harrow, it should be possible to keep the trees permanently under cultivation or semi-cultivation without damaging the roots, a risk that the use of the plough formerly entailed.

With the decline in the prosperity of sheep and cattle farming, the cherry grower has been driven to look for other means of manuring his mature trees through the grass. Some still spread dung when obtainable, others mow the grass periodically and apply artificials, while yet others have allowed "ringed" pigs, flocks of poultry and even geese to try their hand at grazing the cherry orchard. With all these revolutionary experiments going on in the management of cherry orchards, it is possible that some new method may be evolved to replace the traditional system from the past. At the moment it would probably be true to say that the majority of the best growers in Kent still adhere to the theory that it is best to run sheep in the orchard to keep the grass short in the summer, even though they lose money on the sheep by doing so.

The argument seems to be that short grass means a reduced leaf area, leading to a reduction in the loss of water by transpiration through the leaves of the grass and, in consequence, an increase in the amount of water available in the soil for the use of the cherry trees while the fruit is swelling. Implicit in this argument is the idea that moisture is a vital factor in

the successful development of the fruit of the cherry. What is the evidence? So far as the writer is aware, no controlled experiments have been carried out in this country to determine the exact part played by soil moisture in the development of the fruit of the cherry. Until such experimental evidence is available there can be no satisfactory explanation of the apparent paradox that the best cherries in England appear to be grown in an area of comparatively low rainfall and high sunshine in grass orchards by growers who hold the very general belief that adequate soil moisture in the growing season is second only in importance to soil as a factor in the successful culture of the cherry. In the face of this apparent paradox there is at present no satisfactory answer to the heretic who asks, "If soil moisture is so important why not get rid of the grass and try clean cultivation as a means of conserving moisture?" Nothing short of a properly controlled experiment will give the correct answer to this question.

Crops. Cherries, it is generally agreed, take at least 10 years growing before they may be said to be really in cropping, and thereafter the yield varies from year to year according to the weather before, during and for several weeks after blossoming, and again according to the amount of rainfall during the picking season. Some varieties crop in years when others fail; some varieties always manage to carry a crop of sorts, whilst others are invariably shy croppers. Hence it is almost impossible to give a satisfactory average figure for yield of cherries. An official estimate* for 1936 for the whole country gave a total crop of 344,000 cwt. from a total area of 15,446 acres of cherries, or just over one ton per acre. A ton of cherries is approximately 90 "halves," and an acre of cherries comprises from 30-50 trees according to the method and distance of planting. Taking the official estimates of the total crop and total acreage for 1936, the crop per tree, therefore, works out at between 1¾ and 3 halves per tree for the country as a whole in that year. It should be remembered, however, that the official estimate of acreage presumably includes trees of all ages, healthy and unhealthy, productive and unproductive, so that it is fairly safe to assume that any estimate of crop per tree made on this basis is likely to be

* "*Fruit Supplies, 1936,*" published by the Imperial Economic Committee.

abnormally low. At the other end of the scale may be cited the instance of a single cherry tree in Kent which is reputed on good authority to have yielded a ton of cherries in one season. It is certainly not uncommon to be shown individual trees in an orchard and to be told that each will yield in a good year up to 30 halves of cherries. On the whole, reckoning good years with bad, and large trees with those of medium size, it should not be unreasonable to expect a yield of from 5-15 "halves" per tree, according to age and circumstances. How long a tree remains in profitable bearing depends largely upon variety, but also upon management. A period of 40 years of cropping life beginning at the age of 10 years is not unusual in Kent.

THE HISTORY OF SAINFOIN IN GREAT BRITAIN

J. R. THOMSON, B.Sc., B.Sc. (Agric.),

Department of Agricultural Botany, University of Reading

The first part of the word *Onobrychis* (the genus to which Sainfoin belongs) comes from the Greek *onos*, an ass, but the meaning of the remaining part of the word is obscure. It has been suggested that " brychis " is derived from *bruchis*, a plant, because Sainfoin provided a fodder to which asses were particularly partial, and there are other explanations, based on the derivations of the word, that are equally speculative, and which will not here be perpetrated.

Many English names have been given to this plant, such as Sainfoin, Holy or Holly Hay, French Grass, French Finger Grass, Everlasting Grass, Medick Vetchling, Cockshead, Esparcet and Snail Grass. The most commonly used name, Sainfoin, is derived from the French, either " sain foin " meaning wholesome grass or from " saint foin " meaning holy grass. Sainfoin has a reputation for wholesomeness, and there is a legend that Christ's manger was filled with Sainfoin hay. Sir John Pettus,[1]* in a pamphlet published in 1674, explains that:—

> It is the most wholesome grass that cattle can eat, from whence some hath thought it to be called St. Foine, that is to say *sanum fœnum*, but 'tis indeed called in French St. Foine, that is *sanctum fœnum*, for that as some say it may seem to spring out of the earth, as it were of a more especial favour of God, not only for the nourishing and fatting of herds of cattle, but also to serve for physick for beasts that are sick, and in that respect is called of the Latines *Medica*

That the name is really derived from " saint " is indicated by the fact that all the early writers call it Saint Foin, though spelling it in different ways such as St. Foyne. The names French Grass and French Finger Grass were used in the seventeenth and eighteenth centuries because of its country of origin. Its reputation for longevity earned it the name of Everlasting Grass. For instance, Jethro Tull[2] says " I never knew a plant of St. Foin die a natural death," and much later Lawson[3] understands that " plants (of Sainfoin) have

* For references see p. 337.

been known to exist for nearly a hundred years." The supposed medicinal value of the plant explains the name Medick Vetchling, which has been applied to it. Cockshead is another name for Sainfoin, and Esparcet, a French name, has also occasionally been used. Worlidge, in his "Systema Agriculturae" (1681), says "Esparcet is a kind of Sainfoin, and by some judged to be the same." The name Snail Grass may perhaps owe its origin to a supposed liking of snails for the leaves.

Sainfoin is a native of England, but the first crops grown in this country were from seed imported from France where it had long been grown as an agricultural crop. Lawson puts the date of its introduction at 1651, but it appears to have arrived earlier than this. The romantic story of its introduction is given by Charles Kirkham[4] of Fineshade Abbey, Northamptonshire, in a pamphlet published in 1726.

> This narrative I received from that learned, wise, generous and noble, the late Lord Hatton, which he received from unquestionable hands

According to this account, Charles, Prince of Wales, when his marriage to Princess Maria, Infanta of Spain, was mooted in 1623, decided to go and woo the lady himself rather than have it done by proxy, as was the custom. Accordingly he set off, accompanied by the Duke of Buckingham, to travel incognito through France and Catalonia to Madrid. On the way they visited Monsieur Fluery, a wealthy Frenchman, whose acquaintance the Prince had made some years previously in England. In Fluery's park Charles amused himself hunting the red deer, "the noblest and largest red-deer the Prince ever saw, far larger than what England affords, or what is bred in the northern parts of France." When James I died and Charles came to the throne, Fluery decided to visit England again and, remembering Charles' oft expressed wishes, thought of taking some of his deer as a gift. Accordingly, he prepared a "terrestial ark" for the conveyance of the deer, set off for England himself and left his men to follow with the deer. Before they reached Calais, the animals went off their food and looked as though they would not survive the journey. The rest of the story is best told in Kirkham's own words:—

> A countryman standing by, and pitying the misfortune, said he believed he had something in his barn which they might eat, they asked what it was, he answered Saint-Foint-Hay, they told him that seemed not very probable, since they had before them the best and most natural food that

could be got for them, he said, it was but trying, and the charge would be but little. So they desired him to fetch some, which he immediately did, and they being taken out of their carriages, and laid in an orchard or inclosed place, began by degrees to feed upon it, till at last it recovered them so, that they not only eat of that, but anything that was natural to them so that after some time they recovered of their weakness, and became so strong as to be conveyed into England, where they were presented to the King, then put into Hyde Park, where they encreased and multiplied, until the Civil Wars, that destroyed everything that was honourable, good and valuable. This noble present, together with the immense charge and difficulty, became for some time the chief subject of the court, and the food and other circumstances of preserving their lives, being enquired into, (which was so wonderful) was Saint-Foin, and that it grew upon the mountains and stony land in Normandy the Marquis of Newcastle, made afterwards Duke of Newcastle, for his loyalty to his prince, and Sir John Walters of Oxfordshire, one of the ancestors of that ancient family still in being, having abundance of land that was fit for it, sent over for the seed, and the way of managing it, who were the two first fortunate persons that made the experiment, and raised their lands from 100 pounds a year, to 700 a year

If the Sir John Walters mentioned above can be taken to be the judge who died in 1630, the date of the introduction of Sainfoin into this country would seem to have been at some date between the accession of Charles in 1625 and the year 1630. Against this assumption must be mentioned the fact that the Marquis of Newcastle did not receive his title until 1643. Kirkham's reference to Newcastle's title, however, may have been due to a lapse of memory concerning one who changed his title so frequently, for he was christened William Cavendish in 1592, became Viscount Mansfield in 1620, Earl of Newcastle in 1628, Marquis of Newcastle in 1643 and Duke of Newcastle in 1665. In any event Lawson's suggestion that the date of the introduction of Sainfoin was as late as 1651 would seem to be at variance with the testimony of Walter Blith[5] in a book published in 1652 in which he says, "It hath been sown in divers parts of England, as in Cobham Park in Kent, etc., where it thrived very well upon chalkie drybanks."

As might be expected, the cultivation of this new plant spread very slowly at first, and twenty years later intending growers still had to obtain their seed from France. Sir Richard Weston, in his "Legacie"[6] written in 1645, complained that Sainfoin was being neglected, but in 1652 Walter Blith[5] reported that it had been sown in a number of districts. After the Civil War its cultivation became more popular, and by 1674 Sir John Pettus[1] was able to write of it as though it were a common crop, and to give very practical instructions

as to its culture obviously based on long experience. He also reproved those who wanted to prohibit the growing of Sainfoin because it would make fodder too abundant and lower the price of cattle. The crop was tried out all over the country and there are reports of its being grown in Yorkshire and even as far north as the Lothians.

The early writers were enthusiastic about Sainfoin and did not stint their praises. Phrases such as "Wonder of Nature" and "Terrestial Phaenomenon" are typical. They laid particular stress upon its value for improving barren lands. Its advantages are well summed up in the pamphlet attributed to Sir John Pettus.[1] He considered that:—

1. It improves the soil and subsequent crops.
2. "The grass and hay, that is raised thereby, is beyond all sorts of grasses and fodder, in that it is not only meat, but medecine."
3. It is deep-rooted and survives drought.
4. It is good for breeding and fattening cattle and for milk. "The dairymaid shall in one week's space find a great alteration for the better, both in the colour, quantity, and quality of the milk, from what any ordinary pasture will yield."
5. Bees are fond of it and it will increase and improve the honey

Jethro Tull[2] gives his argument that Sainfoin is easy to make, a queer twist:—

> In other countries people are not prohibited using the necessary labour on all days for preserving their hay, even where the certainer weather makes it less necessary than here, yet 'tis otherwise in England; where many a thousand load of natural hay is spoiled by that prohibition for want of being opened; and often by the loss of one day's work, the farmer loses his charges and one year's rent, which shows that to make hay while the sun shines, is an exotick proverb against English laws, whereunto St Foin being, in regard of Sundays and holidays, more conformable, ought to be the hay as proper to England as those laws are

There are two main varieties grown in England to-day—Common or Single-cut Sainfoin, known botanically as *O. viciaefolia Scop.** var. *communis*, and Giant or Double-cut Sainfoin, known botanically as *O. viciaefolia* var. *bifera* The difference between them appears to be primarily physiological. Common Sainfoin, after flowering and having been cut for hay, produces no more stems and flowers and the aftermath is suitable for grazing only. Giant Sainfoin, however, after cutting sends up tall stems again and flowers a second time so that a second crop of hay can be taken, and it may even flower a third time. A third variety or form has been described, Three-cut Sainfoin (*O. viciaefolia* var.

* = *O. sativa* Lam.

maxima), distinguished by the character of thrice flowering, but this character is not constant and it should be regarded as the same as the variety *bifera*.

It has always been assumed that the Sainfoin grown in this country was all of the Common type until the introduction of Giant about a hundred years ago, but there is evidence that plants showing the Giant characteristics were being grown long before this period. For instance, Tull (1733) says that it may give two crops of hay on rich sandy soil; an " English Gentleman " in a communication to the Honourable Society of Improvers at Edinburgh sometime before 1743 said: " The third year you may mow twice "; and " P.W." an Essex farmer writing in the Bath Society's Papers in 1783 says that two good crops can be obtained from rich land. The comments made when Giant Sainfoin as we know it to-day was introduced are much to the point in this connexion. Some writers, such as Thomas Hine,[7] laid emphasis on the second and sometimes third flowering of the new variety, but others such as Lawson, the Edinburgh seedsman,[8] and John Wilson, a Berwickshire farmer,[8] described it only as flowering earlier and growing more rapidly than the older variety, as though twice flowering were no novelty. This matter, however, can be put beyond all doubt by a report on some Common Sainfoin sown by Peter Lawson[9] in 1834. In 1835 it flowered on June 8, was cut and flowered again on September 20. The original seed imported from France and grown in this country must therefore have been a mixture of Giant and Common types. It is clear from Ray's description (1686) of Sainfoin culture in Savoy, that the Giant type was being grown in France in the seventeenth century. It appears that a clear cut distinction between the two types has been drawn in this country within the last century only.

The cultivation of Giant as a distinct variety dates from the 1830's. Lawson of Edinburgh received some seed under the name of *O. sativa* var. *bifera* from M. Vilmorin and Co., the well-known Paris seed merchants, in 1834, but very little seed appears to have been distributed from this source. The main source was in Hertfordshire as to which Thomas Hine,[7] writing in 1849, gives the following account:—

The Giant Sainfoin as it has been styled by Mr. Hart, of Ashwell, Herts, the fortunate introducer thereof, was totally unknown in this neighbourhood until about twenty years ago. It was then, on Mr Hart's inquiring in the market for Sainfoin seed, that he was apprised by the

late Mr. Carrington, of Shefford, Beds, that he had twenty bushels of old seed he was at liberty to try; for which, if it did not grow, he would make no charge. These terms being accepted, the seed was sown . . . and turned out to be a distinct species of the plant. . . . The crop thus obtained was mown for hay in the usual way: but Mr. Hart was surprised to find, that about six weeks after it presented him with another crop in full flower This also was mown for hay; but in September it came again into flower and again was cut for hay.

Joseph Hine,[10] Thomas' son, writing in 1847 says:—

It was clearly a foreign species, but although various purchases of foreign seed have subsequently been made, in hopes of obtaining the same variety, they have hitherto proved unsuccessful.

The exact method by which Giant Sainfoin appeared in this country is therefore a complete mystery. It was certainly an exceptionally good form of Giant and showed its thrice-flowering character very consistently, at least while grown in Hertfordshire. Thomas Hine appears to have done very well for himself by selling the seed at high prices. In his article, quoted above, he reproduces numerous letters received from farmers who had bought seed from him; they come from Cambridge, Beds, Lincs, Essex, Kent, Bucks, Berks, Hants, and Dorset.

Some confusion has been caused by a statement made by Professor Wilson in his book " Our Farm Crops " published in 1853. He says:—

A variety differing but slightly from the Common was introduced in 1834 under the name of *O. sativa* var *bifera* from France. . . More recently a large variety, to which the name Giant Sainfoin is given, has been introduced

The former clearly refers to the Edinburgh introduction; the latter most probably refers to the Hertfordshire introduction, though actually this preceded Lawson's introduction in time. The impression here given is that Giant Sainfoin does not belong to the variety *bifera,* but that this meaning is not intended is shown by a statement made later in the same chapter: " Giant Sainfoin—var. *bifera*—is generally recommended."

Since that time the history of Sainfoin has been uneventful. In the 1850's the practice of milling the seed began and from 1900 to 1904 the first yield trials on a field scale were carried out at Woburn. The position of Sainfoin in British agriculture to-day is difficult to gauge since no statistics of acreage are available, but it has fallen far short of the enthusiastic prophecies of the early growers. It

probably occupies a larger acreage than Lucerne, but it certainly falls a long way behind the staple clovers. Sir John Sinclair considered it to be " one of the most valuable grasses we owe to the bounty of Providence," but for one reason or another it has never become generally popular with farmers.

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2 Jethro Tull *The Horse-Hoing Husbandry* London 1733

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LAND DRAINAGE: AN ACCOUNT OF RIVER IMPROVEMENT WORKS AND WORKS OF COAST PROTECTION IN THE RIVER ANCHOLME AND WINTERTON BECK CATCHMENT AREA

A. R. HAYNES, F.S.I.,
Engineer to the Catchment Board

The River Ancholme and Winterton Beck Catchment Board was constituted under the Land Drainage Act, 1930, on April 10, 1931. The Catchment Area is approximately 238 square miles in extent, and drains into the Humber tidal estuary. An area of approximately 38 square miles lies below the level of high water level of spring tides in the River Humber and is protected therefrom by some 6 miles of embankments.

On February 2, 1933, the Catchment Board took over from the old authorities 98 miles of " main " river. Of this, 51 miles (including the canalized New River Ancholme, 20 miles in length) were transferred from the Commissioners of the Ancholme Drainage and Navigation, a body exercising jurisdiction in the Level of Ancholme; and a brief reference to the history of the drainage of the Level of Ancholme will show the continuity of the efforts that have been made from time to time, according to the means at the disposal of the authorities, to protect the lowlands from inundation by the tidal waters of the River Humber and the fresh waters of the Catchment Area.

Historical Outline. It was not until 1635 that a determined effort was made to make the drainage of the Level of Ancholme efficient. Prior to that date the natural watercourse of the Old River Ancholme remained in open communication with the River Humber, and records dating back to the 13th century show that the very occasional scouring out of the River Ancholme and a number of streams discharging into it was the only work carried out to assist the drainage. Between 1635 and 1639, however, the New River Ancholme was cut, with the object of providing a more commodious passage for the flood water through the Level than

the meandering course of the Old River Ancholme had been able to afford, and the first sluice was erected at its outfall in order to stem the tides of the Humber.

During the first half of the 18th century, the drainage works were once again neglected and the sluice was broken down. This state of affairs was not allowed to continue long. In 1767, the Landowners applied for, and obtained, the Royal Assent to " An Act for the more effectual drainage of the lands in the Level of Ancholme in the County of Lincoln and making the River Ancholme navigable . . . . ," under which the body known as the Commissioners of the Ancholme Drainage and Navigation was set up.

The Commissioners improved the New River Ancholme and erected a new sluice at the outfall (at South Ferriby) together with a new lock 14 ft. 9 in. wide and 70 ft. long. Yet the drainage of the lowlands during periods of heavy rainfall was still in a very defective state, because the sill of the new sluice was laid 8 ft. above the level of L.W.O.S.T. in the River Humber.

In the year 1800 Mr. John Rennie was consulted, and he recommended that the New River Ancholme should be widened and deepened, that two new locks should be built to preserve the Navigation, and, with a view to preventing the floods from the high lands from drowning the level, he proposed that two catchwater drains should be made in the line of the base of the highlands, bordering upon the Level, with separate and independent sluices at their junction with the River Humber. These works were only partially carried out, mainly owing to the lack of sufficient funds, and as the drainage was still very inefficient and complaints were universal, the Commissioners in 1824 consulted Sir John Rennie. Sir John recommended (amongst other things) that the Catchwater Drains as proposed by his father should be carried out to their full extent; that the New River Ancholme should be widened, deepened and enlarged to double its then capacity, and that a new sluice should be constructed at South Ferriby with its sill laid level with L.W.O.S.T. in the River Humber, together with a new lock 20 ft. wide

An Act of Parliament for these objects was obtained in 1825, and the works were commenced forthwith, but progress was slow owing to rating disputes, and the fact that the cost was a heavy burden on the lands lying within the Level. By 1844, however, the New River Ancholme had been improved,

although it was not deepened to the extent proposed by Sir John Rennie, and the new sluice and lock at South Ferriby had been completed, but the catchwater drains had only been partially made, and have never in fact been completed.

From 1844 until the constitution of the Catchment Board, no works of any magnitude were carried out. Meanwhile there appears to have been a general subsidence due to shrinkage of the land within the area, while the general level of water in the New River Ancholme had been maintained for navigation purposes, and therefore the drainage of the lowest lands was far from satisfactory.

Improvement of the New River Ancholme. As a first step, the Catchment Board had a detailed survey made of the New River Ancholme. In due course this survey became the basis of a scheme for improving and lowering the bed of the river, so that the general level of water maintained for navigation purposes could be lowered for the benefit of drainage without reducing the draught of vessels navigating the river, and so that there would be a quick discharge of flood waters in periods of heavy rainfall. The scheme also made provision for the improvement of the length of the Old River Ancholme passing through the town of Brigg, and for three other subsidiary works, one with the object of providing an outlet into the New River Ancholme for an area which has hitherto discharged its waters into the eastern catchwater drain, and another for increasing the efficiency of one of the sluices at South Ferriby. The estimated cost of the scheme is £22,305, towards which the Ministry is contributing a 60 per cent. grant under Section 55 of the Land Drainage Act, 1930. The work of improving the New River Ancholme and the Old River Ancholme through Brigg has been completed with the exception of the lowering of the bed of the New River Ancholme along a short length where it consists of rock. The work has been carried out by bucket dredger, the spoil being deposited on the banks, except in part of the Old River Ancholme through Brigg, where buildings come up to the water's edge. (See Fig. 1.) In this part a grab dredger was used, the spoil being deposited into barges which were emptied at a spoil depot some distance away. Although the low-lying lands cannot receive the full benefit of the scheme until the rock bottom has been lowered and the present Navigation level reduced, it has already been proved that the run-off into the River Humber

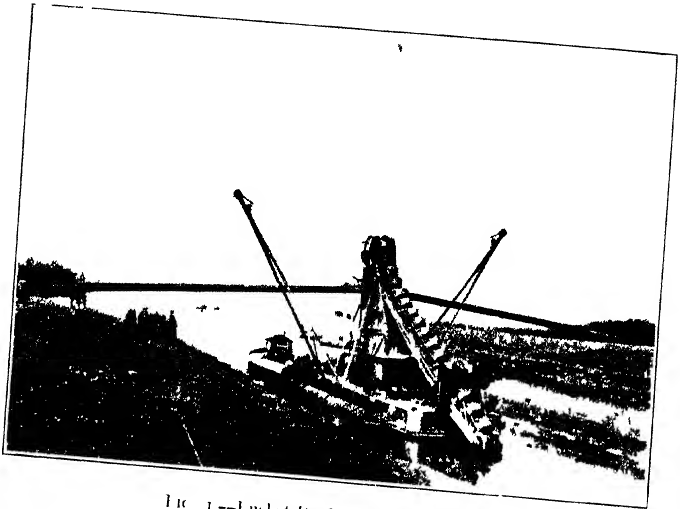

Fig. 1.—Bucket Dredger, R. Ancholme

Fig. 2.—Mattress in the making. Laying the foundation of [illegible]

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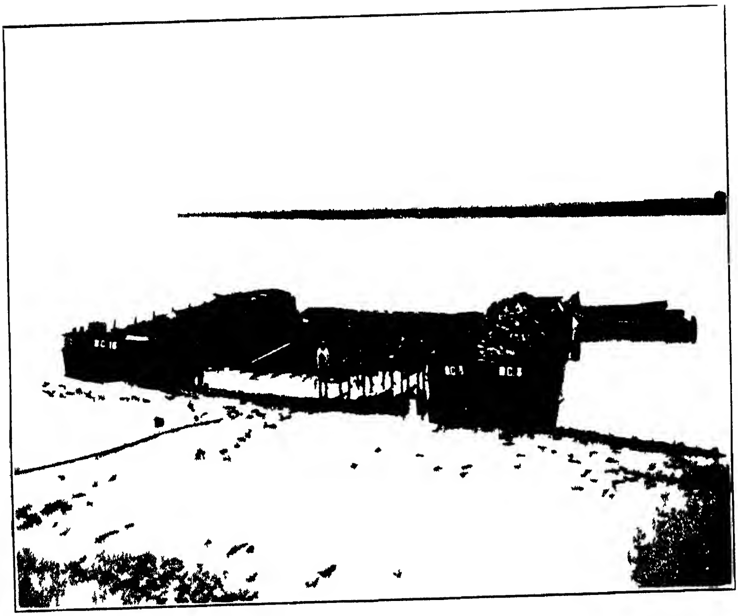

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Fig. 5. Further Stage in Sinking of a Mattress

Fig. 6. Placing Stone Pitching in position

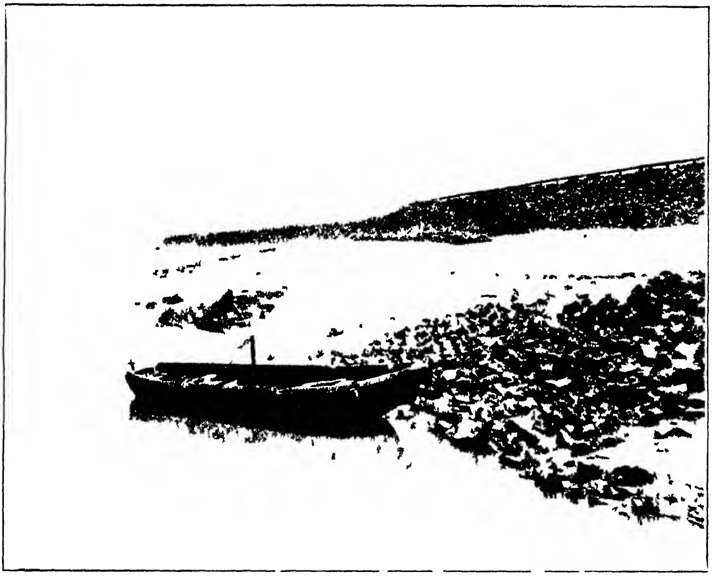

Fig. 7. Showing Mattress buried by accretion on the lower slope

Fig. 8. Near view of Stone Pitching and Mud Slope

during periods of flood has been increased by approximately 80 per cent.

Humber Erosion. The sluices at South Ferriby are capable of stemming the tides of the River Humber at that point, but the Catchment Board soon found that although they had not to provide for new sluices as their predecessors had been compelled to do in 1767, they had to provide for tidal defence works along other parts of the frontage of the Catchment Area to the River Humber.

The tides of the River Humber have been encroaching upon the Lincolnshire shore to the west of the outfall of the River Ancholme for many years. Hundreds of acres of fertile land have been washed away, and actual surveys made in 1846 and 1888 show that the rate of erosion between those dates averaged about 15 ft. per annum. The adjoining lands have always been protected by earth embankments, built ever further and further inland either by parish authorities acting in pursuance of Inclosure Awards or by individual landowners. Between 1931 and 1935 several new flood banks were erected by the landowners, but in 1935 it became apparent that the erosion was being accelerated by changes in the direction of the Humber currents and that flood banks at a number of places were in danger of collapse.

After considering the general situation, the Catchment Board prepared a more comprehensive scheme of erecting new flood banks, the total length of the new banks being approximately 1,350 yards, and the work was completed in 1936. The cost of the scheme was £2,328, towards which the Ministry made a contribution of 50 per cent. under Section 55 of the Land Drainage Act, 1930.

New flood banks, however, could do nothing to stop the continuous erosion, the effect of which was soon to be felt in a more serious form. During 1935, cracks appeared in the main road from Scunthorpe and the west to Barton on Humber where it runs near to the foreshore for a distance of about 1,000 yards. Some years ago, the highway authority began to protect the foreshore with stone pitching in order to avoid the necessity of diverting the road, but it became clear that stone pitching was no longer an adequate protection. The situation thus created called for co-operation with the highway authority, and after conferences between the Catchment Board and that authority and representatives of the Ministries of Agriculture.

and Transport, it was decided that measures should be taken to stop the erosion once and for all. The Catchment Board advanced for consideration the brushwood mattress method of stabilizing the shore line, and eventually detailed schemes were prepared involving the use of this type of protection along the whole length of the shore line between the outfall of the River Ancholme and Winteringham Haven (about 2¾ miles) where protection is necessary.

Three schemes have so far been prepared, two of which have been adopted. The first scheme covered the foreshore where the road was in danger (about 1,000 yards in length) and was completed in August, 1937. The cost of the work was £37,000, of which one-half was regarded as the cost of works for the protection of the road. The Ministry contributed 60 per cent. of the Catchment Board's half share of the cost under Section 55 of the Act of 1930. The second scheme, which deals with a further 1,300 yards west of the length covered by the first scheme, is now in progress, and will be completed by September of this year. Its estimated cost is £25,000, towards which a contribution of 66⅔ per cent. is being made by the Ministry under Section 55 of the Land Drainage Act, 1930.

The essence of the problem is, of course, protection from scour at the toe of the slopes under low water, as, until the foundations are secured, any protection works towards the top of the slope have no permanent base upon which to rest. The first part of the work, therefore, consists of protecting the under-water slopes of the bank. For this purpose, a series of strong points are being constructed, extending down well on to the river bed and at distances apart so determined as to control any erosion that may take place between them.

The footings of these strong points consist of groups of brushwood mattresses, about 2 ft. in thickness, extending from about the low-water spring tide level down on to the river bed, sunk and weighted down with stone. As the depths of the channel and other circumstances vary, the dimensions of the mattresses are calculated to meet such contingencies, and they are finally covered with about half a ton of stone per square yard. Some of the mattresses are protecting the toe of the slopes 43 ft. under the low-water level, but their unique combination of strength and flexibility enables them to meet the attack of the tides successfully.

When the mattress protection of the slopes under low water

is completed, special slag-pitched buttresses are laid upon the slopes from the outer edges of the flank mattresses in each group, just above the low-water mark up to just above half-tide level. The base line and sides of the buttresses are held by sheet piling, and the cross sections of these buttresses are so designed as to help the flow of water over them. The upper ends of these buttresses are carried into stone pitching, which is carried along up to the high-water mark over the whole length of the protection scheme. In this way the bank at the strong points is fully protected from the bed of the Channel up to the high-water mark. (See Figs. 2-8.)

The first scheme was commenced in October, 1936, and some of the mattresses have been in position for a considerable time, and the accretion on the site is very substantial. There is every reason to suppose that the shore line so far as the work has gone will be permanently stabilized, and one result of this has been to promote confidence in the neighbourhood as being suitable for industrial development. A new cement manufactory has already been built, a new petrol distillery is in course of erection, and other developments are likely to take place in the near future.

The total area of lowlands benefiting from these works is approximately 36,000 acres, of which the greater part is agricultural land.

COMBINED SEED DRILL AND DUSTER

H. Martin Leake

and

W. A. R. Dillon Weston

In recent years the technique of controlling certain seed-borne diseases of cereals has undergone a considerable change. The use of wet treatments, such as formalin, has given place in many instances to the use of dust disinfectants containing certain salts of mercury, and the use of these has given very satisfactory control not only of bunt of wheat, covered smut of barley and smut of oats, but of leaf spot of oats and leaf stripe of barley—two diseases that were not adequately controlled by a wet treatment. Apart from this aspect, however, it is generally held that the advantages of a dry over a wet treatment are (1) that the dry treatment, if correctly applied, does not injure the vitality of the grain, and (2) that the treated grain need not be sown immediately provided that it has been correctly treated and stored. The organo-mercury seed disinfectants now in use are proprietary articles and they appear on the market under various trade names. The composition of these dusts varies with the particular commercial product, but the main ingredients of them are very finely divided inert mineral carriers or fillers with which are mixed or impregnated small quantities of one or more organo-mercury compounds. The seed is treated by mixing it in a revolving drum for two or three minutes with the appropriate amount of the dust disinfectant. The treatment of the grain in this way results in an even coating of the fungicide over each seed and thus ensures its disinfection in a satisfactory manner. Even though the treated grain becomes re-contaminated, the fine dust disinfecting layer over each seed will prevent infection taking place.

This method of treatment, however, is sometimes criticized on the following counts:—

(1) The treatment necessitates the purchase of a machine for treating the grain.

(2) It involves recurrent labour charges for de-sacking, dressing and re-sacking the seed, and the cleansing of sacks which have held treated grain.

(3) The disinfectant dusts are poisonous and consequently precautions must be taken when using them

The first criticism is one which in some measure may be discounted, for there are several relatively inexpensive types of machines on the market which effectively serve the purpose and the upkeep of which is negligible. It is, however, a relatively simple matter to construct a home-made machine from a disused old butter churn or a clean sheet-metal drum fitted with a handle and mounted on a pair of bearings. Moreover, many seed firms now offer ready-dressed seed for sale.

The second criticism is a more valid one, but even here the recurrent labour charges are very similar to those involved in the treatment of grain with the older liquid preparations. The more cogent argument is that these dust disinfectants contain organic compounds of mercury, and consequently the usual precautions in dealing with a poison should be observed. At the same time it must be borne in mind that approximately 97 or 98 per cent. of the dust which is used consists of the inert filler or carrier and two or three per cent. only—and sometimes less—of the poisonous salt. The manufacturers of these products, however, state that it is advisable to avoid inhaling the dust and that the nose and mouth should be protected with a cloth or respirator. Some of these products should not be handled with wet or moist hands and should not be allowed to come into contact with wounds or broken skin since they have a vesicatory action. After the treatment has been carried out, any dressing remaining on the hands should be removed by rinsing thoroughly. No dressed seed should be used for feeding purposes and bags which have contained dressed seed should be shaken out or washed before being used for carrying fodder. If the machine used for the purpose of dusting the grain is not adequately dust proof, then it is clear that the operator cannot avoid inhaling some of the disinfectant dust, and consequently, if dust-proof conditions cannot be secured, masks or respirators should be worn. Any danger should, if possible, be minimized by carrying out the dusting operation in the open air and not in a closed barn or shed. The practice sometimes carried out of spreading the grain on the barn floor, scattering the powder over this and then turning the grain over

several times with a shovel is open to the following objections: (1) the dusting operation is not done thoroughly and the grains are not evenly coated with the correct amount of powder and consequently the disease control is less efficient, (2) unless very careful precautions are taken the operator will inhale the dust particles.

If the above criticisms of the "dusting" method of treating seed are tenable ones, an obvious corrective can be suggested and that is the use of a combined seed drill and duster, i.e., a machine that would dust the grain as it was being drilled. The essential feature of such a machine would be that, by a continuous disturbance of the seed while the drill is in motion, the required quantity of dust would be sufficiently evenly distributed over the seed to ensure that all the seed was adequately dusted. This is the basis of the present mechanism. It consists of a shaft running the length of the hopper and carried through the end wall of the hopper nearest to the driving wheel. To this projecting end is attached a cog-wheel which, through an intermediate cog-wheel, is geared up with the feed mechanism. This intermediate cog-wheel is so mounted that it can be thrown in and out of gear at will. The particular method of driving the shaft will, naturally, depend on the type of drill in which it is mounted. The gear ratio is such that, at normal speed of the drill, the shaft executes some ten revolutions per minute. Arranged along the shaft at intervals are a number of arms of such length that their heads sweep the maximum transverse section of the hopper. They are situated spirally, each arm being advanced 45° on the preceding arm. (In practice, standard bolts having a domed round head were employed for the purpose.) These arms are so sited that, in rotation, the heads sweep over the delivery apertures. Additional arms are interpolated so that the inter-arm interval is some 4-6 in. (Figs. 1 and 2). The opposite diagram illustrates the arrangement.

The method of employment is as follows. A bushel of grain is placed in the hopper and levelled off. The correct quantity of the dressing is then scattered as evenly as possible without undue expenditure of time and care, over the surface. A second bushel of grain is then fed into the hopper and dressing scattered in like manner and the process repeated until the hopper is full. The dressing mechanism is then thrown into gear and drilling proceeds in the normal manner.

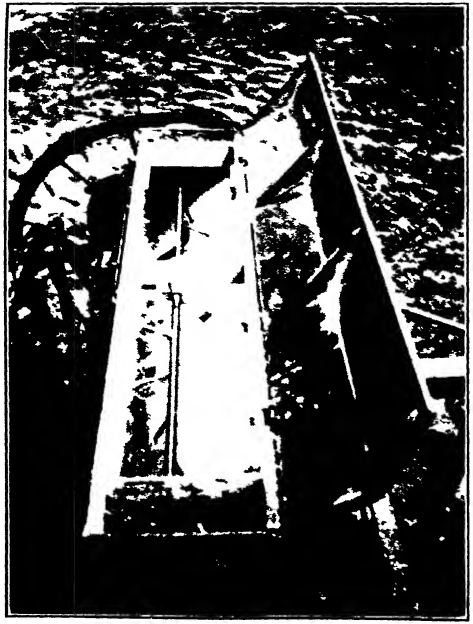

FIG. 1.—Drill seen from above. Showing interior view of hopper.

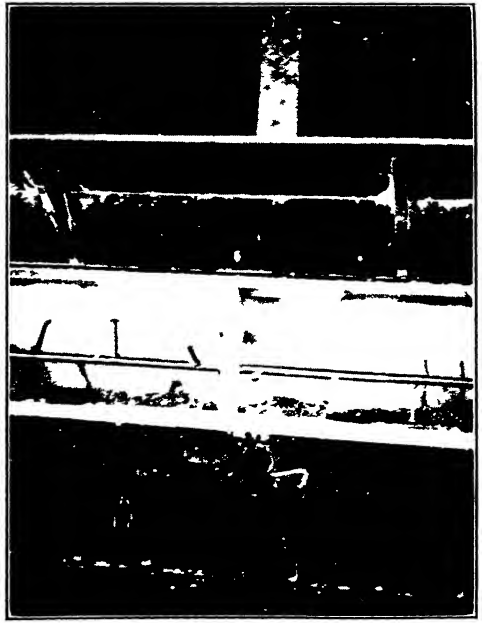

FIG. 2.—A portion of the hopper seen from above. Showing the shaft with stirrer bolts.

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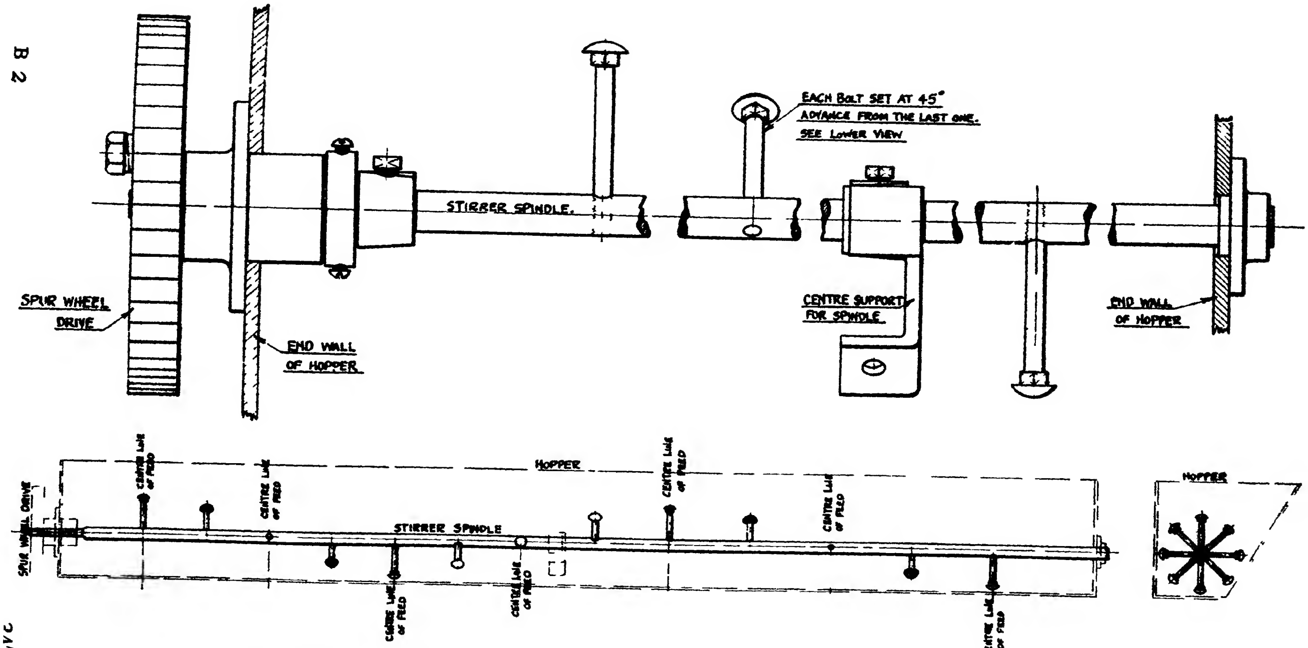

Top Figure —Horizontal view of shaft showing stirrer bolts
Lower Figure —Vertical view of hopper showing siting of shaft
Right-hand Figure —Diagrammatic sectional view of hopper showing siting of shaft

For the first fifty yards of drill run the seed is only partially dressed; subsequently the dressing is adequate. The only precaution required is to see that the hopper does not become empty. If this happens, the first fifty yards following the recharging of the hopper will be inadequately dressed; otherwise no break occurs as the result of recharging.

As the first step, experiments were made in the laboratory with a small scale model of the Precision drill to which a shaft bearing three arms was fitted, the centre arm sweeping over the single delivery aperture. Instead of a disinfectant dust, a water-soluble dye, having the form of a dust, was used, being added to the grain in the hopper at the normal rate of two ozs. per bushel of grain. Samples of the grain were tested after they had passed through the machine by placing them in water. The effectiveness of the dusting operation was judged by the intensity of the colour produced on individual grains. On this basis the operation appeared satisfactory.

Experiments were then made in the field, using both a Precision and a Force-Feed drill to which the dusting mechanism had been fitted. The results obtained were similar with both drills and it is, therefore, unnecessary to discriminate between them. In one case part of a field was sown with oats infected with the leaf spot fungus (*Helminthosporium Avenae*), no dust disinfectant being used. After drilling had been in progress for some time and several acres sown, the hopper, on recharging, was filled with grain and dust in the manner described above and drilling resumed with the dusting mechanism thrown into gear. Observations were made when the seedlings had speared through and it was evident that there was less leaf spot on the area that had been sown with grain that had been treated. A preliminary estimate made on 1,000 seedlings from each area indicated an intensity of leaf spot of 18.4 per cent. on the untreated area where no dust had been applied, while, on the area sown with treated grain, the intensity was only 1.3 per cent. Later, a more detailed estimate was made. One hundred separate one-foot lengths were taken at random in each section of the field and counts of healthy and diseased seedlings made. The total number of seedlings produced from the hundred randomized one-foot lengths, the seed of which had not been treated, was 1,076 and of these 12.5 per cent. were infected with leaf spot. The total number of seedlings arising from

the hundred randomized one-foot lengths of the treated seed was 1,062 and of these 1.6 per cent. were infected. From these figures it will be seen that a good, though not complete, control is obtained with the use of this mechanism.

Further critical experiments have not been conducted, but additional evidence of less critical nature has been obtained. In one instance the hopper of a Precision drill to which the mechanism was fitted, was divided by a vertical partition wall in such a manner that four coulters were fed from one section of the hopper and the remaining eight from the other. In the larger section was placed barley to which disinfectant dust was not added while, in the smaller section, barley with disinfectant dust was added. In this manner four lines with treated grain alternated with eight lines with untreated grain throughout the field. The barley was a sample heavily contaminated with covered smut (*Ustilago Hordei*). No critical counts were made but the field was very carefully searched at harvest. While smut was common, though not abundant, in the untreated rows, not a single instance of the disease was found in the rows from treated grain.

On a commercial farm near Cambridge the whole of the cereal crops have, for the last four years, been sown with a drill fitted with this mechanism and a dust uniformly used throughout. In no case has any appreciable disease been noted. This result was the more satisfactory in that the harvest year 1935 was a particularly bad year in this district for smuts in oats. On the neighbouring farm, where no dust had been used, the attack was so severe that the clothes became blackened in walking into the crop. On the farm where the mechanism was used for dusting, search disclosed only a single smutted ear and a second was found by the labourers during harvest. In the remaining years disease has not been very prevalent and it is unlikely that any but critical tests would have disclosed any difference. Such tests were impossible since the whole crop was treated.

The evidence collected suggests very strongly that the mechanism, while giving adequate control for practical commercial purposes, does not give that complete control which is desired, for instance, by the grower of seed grain for the market. It may, therefore, be pointed out that these results have been obtained with a mechanism designed merely to test a given principle. That the mechanism is capable of modification to give even better results cannot be doubted.

For instance, the hopper of the Precision drill is flat bottomed, and has a vertical rear wall and a sloping front wall, while the cross section of the Force-feed hopper is a truncated V. No rotating arm can adequately sweep an area of a shape such as is formed by the transverse section of either of these hoppers. A more effective sweep would be obtained if one at least of these walls were curved to the sweep of the arms. Again, the arms are composed of standard bolts with round, dome-shaped heads. These give no lateral thrust in passing through the grain. By making them V-shaped with the knife-edge in the forward position, such a lateral thrust would be imparted to the grain and so cause a more effective stirring of the body of the grain lying between the arms. Whether these changes would give that control which is desired by the supplier of the seed market as well as the ordinary farmer, is a matter only further experiment can decide. Such seed is, however, only a fraction of the seed grain now dusted.

THE COST OF A WEANER

A. J. Marval, M.A., N.D.A., N.D.D.,
The Lord Wandsworth Agricultural College, Hants

In the issue of this Journal for September, 1933, the cost of raising pigs to weaning age on the farm of the Lord Wandsworth Agricultural College, Long Sutton, Hants, for a period of two consecutive years ending March 31, 1933, was given. The present article gives similar and comparable figures, also compiled from data contained in the farm's costing records and accounts for the succeeding 3-year period ending March 31, 1936, and the findings of the five years' investigation are also reviewed.

Under the system adopted on this farm, the breeding herd, running in large grass paddocks provided with wooden, straw, or corrugated-iron shelters, is maintained in open-air conditions for most of the year. The sows are brought into sties adjoining the paddocks in order to farrow down. As soon as possible after farrowing, the sow and her litter are removed to a smaller grass enclosure and remain there until ready for weaning. The weaners are then transferred to the fattening premises, which, being practically half a mile away from the breeding sties, can be regarded as a separate unit. The sows are mated as soon as possible and return to the larger grass paddocks until their next farrowing. The practice adopted on this farm of allowing the pigs to run out to grass at an early age has undoubtedly considerably reduced the mortality, so often common among young sucking pigs, and probably accounts in some measure for the relatively large number of weaners raised per sow.

In the earlier years, Middle White boars, and Large Black, Large White, and Wessex Saddleback sows were employed, but when a bacon contract was first undertaken late in 1933 the dual purpose type of pig produced by such breeding was no longer suitable and some very bad grading tickets were returned. During the last three years reviewed in this article a change has gradually been brought about in the conformation of pigs bred on the College farm, by the use of pedigree

Large White boars on a rather lengthy type of Large White-Middle White cross.

In addition to grass, the breeding stock receive a supplementary meal ration, fed wet, the actual amount given varying according to the relative abundance or scarcity of the grazing, the stage of gestation, and, when suckling, the age and size of the litter. The constituents of the ration are purchased according to their unit price and then mixed on the farm; they consist very largely of milling offals, barley meal, rice meal, flaked or maize meal, with a small addition of soya-bean or white-fish meal to supply the protein and mineral requirements. In this way cheap feeding has been accomplished, a very important consideration, for food constitutes at least two-thirds of the total cost of maintaining a breeding herd. Little use is made of homegrown foods, and yet the meal cost per cwt. is low, as is shown in Table I:—

TABLE I.—AVERAGE COST OF FARM MIXED MEALS

Year	*Cost per cwt* s	d
1931–32	6	2
1932–33	6	2
1933–34	5	9
1934–35	6	6
1935–36	6	3½

The system of separate premises for breeding and fattening, combined with cost accounting, provided a distinct advantage from the point of view of one endeavouring to compile accurate costs, for it made it possible to determine exactly the total weight and cost of the food consumed by the breeding herd. Unfortunately this was no longer possible after the end of 1936, for the farm's pig unit was reorganized so that both breeders and fatteners were fed from a common store. It has been impossible, therefore, to offer an accurate cost figure for raising a weaned pig after the end of the 1935-36 year.

The Cost of Maintaining the Breeding Herd. This is shown in detail in Table II for each of the 3 years, 1933-36. Similar data is given in the previous article for the two years preceding this period. During the entire 5-year period the herd was maintained at a fairly constant strength of 20-25 sows and gilts, the latter all being homebred, with one or two pedigree purchased boars.

TABLE II.—TOTAL COST OF MAINTAINING THE BREEDING HERD

ITEM OF COST	1933–34 £	s.	d.	1934–35 £	s.	d.	1935–36 £	s.	d.	1931–36 *Average* £	s.	d.
Food	186	5	4	184	6	6	163	18	2	187	11	4
Labour	60	0	10½	63	17	4	52	17	7	57	10	0¼
General Expenses		16	0½	2	3	2		3	9	1	0	1¼
Depreciation on Appliances ..	17	2	2	10	3	0	16	7	5	14	19	1¼
Establishment Charge ..	23	3	5	26	8	0	16	13	8	19	4	8¼
TOTAL COST ..	£287	7	10	£286	18	0	£250	0	7	£280	5	4

In order to achieve a clearer interpretation of these figures it is important to note that:—

(*a*) The *Food* item included rent of 13 acres of pasture and any homegrown food given to the pigs The latter is charged at *market price* and all purchased foods at their cost *at the piggery*, thereby including all rail expenses and cartage costs from station to farm.

(*b*) The *Labour* item includes a proportion of the attendant's annual wage, half the annual rental of his cottage, and a charge for any manual and horse labour employed by the pig-breeding department. One man attends to both breeding and fattening herds, but since no detailed time sheet is kept, it has been impossible to decide with absolute accuracy what proportion of his time is spent at either premises. Nevertheless, by judicious enquiry and personal observation, it can be said with confidence that, taking an average throughout the year, one-third of his day is employed in attending to the breeding stock. Accordingly, this proportion of his annual wage has been charged to the breeding department.

(*c*) In this account of costs there is no mention of any *Livestock Depreciation* charge. Actually, over the entire period of five years, there was an average annual *appreciation* in the total value of the breeding herd amounting to £7 11*s*. 4*d*., but, for the reason given below, this has not been taken into account in arriving at the annual cost of maintaining the herd.

In calculating this figure, sows and boars on hand at the beginning and end of each year were allotted a flat rate value of £7 each, and gilts of £3 each. Purchases consisted solely of stock boars, these being entered in the books at their actual cost delivered to the farm. Sales, consisting of breeding stock no longer suitable for the purpose, were entered at their selling price less carriage and market expenses. In preparation for sale they were given a brief fattening process for which purpose they were moved from the breeding department to the fattening sties, where they were fed from the same bucket as the stores for the pork or bacon market. No accurate record, therefore, could be kept of the quantity of meal consumed by them, and for this reason the figure showing an appreciation in the value of the herd is obviously misleading and has been ignored.

(*d*) *Depreciation of Appliances* does not include the decrease in value during the year of the cheaper pig appliances, such as buckets These are regarded as items of recurring expense and are included under the heading of "General Expenses"

(*e*) The breeding herd bears half of the total *Establishment Charge* accorded to the pig department as a whole. This is apportioned over the farm on the basis of manual and horse labour employed by the individual departments

(*f*) No credit is allowed to the pig account for manure produced, but, on the other hand, no charge is made for straw.

TABLE III.—INDIVIDUAL ITEMS AS A PERCENTAGE OF THE TOTAL COST

ITEM OF COST	*Percentage of the Total Cost* (*average* 1931–36)	*Range of Variation* (*percentage*)
Food	66·82	64·2 –72·51
Labour .. .	20·56	17–86–22·20
General Expenses .	0·36	0·05– 0·80
Depreciation on Appliances	5 39	3·60– 6·60
Establishment Charge .	6·87	3·88– 9·20

The *Total Maintenance Cost* was greatest in 1931-32, viz., £301 1s. 0*d*., but considerable economies were then brought about in the actual quantity of food fed and, since food assumes such a high proportion of the total cost, the effect of this was immediate. Since then the food charge has fluctuated quite narrowly between £160 and £190 per annum.

From Table III it may be seen that the only other single item of expense of considerable importance is that of *Labour* which constitutes about one-fifth of the total cost of the breeding herd. It is not necessary to emphasize further the need for economical feeding and the most efficient organization of available labour if the breeding herd is to be cheaply kept.

Litter Averages. Attention directed solely to the cheap maintenance of the breeding herd as a whole will not achieve the main objective of rearing pigs cheaply to weaning age unless the productivity of the herd, in terms of weaners raised per sow per annum, is maintained at a high level of efficiency.

During the two years previously reviewed in greater detail, data was not available for the calculation of a "litter average" figure. For the next three years, however, a strict record was kept and a summary is made in Table IV. It includes figures for all farrows from sows and gilts both

winter and summer born, and, as a matter of interest, the comparable figure for 1936-37 is also included. Over the 4-year period, April, 1933-March, 1937, an average of 8.75 pigs weaned from a total of 163 litters born is obtained. It will be realized that this figure is relatively high and to this fact the low cost of producing weaned pigs on the College farm can be attributed to a large extent.

TABLE IV.—AVERAGE NUMBER OF PIGS WEANED PER LITTER BORN

Year	*Litters Born*	*Pigs Weaned*	*Litter Average Weaned*
1931–32	—	340	—
1932–33	—	375	—
1933–34	41	351	8·56
1934–35	45	370	8·22
1935–36	37	313	8·46
1936–37	40	393	9·80

The Cost of a "Weaner." This figure can be obtained by splitting up the total breeding herd maintenance cost equally over the total weaners raised in the same year. The annual fluctuations in weaner cost over the entire 5-year period may be seen in Table V, while in Table VI the cost in each of the three years from 1933-36 is analysed into its component parts:—

TABLE V—TOTAL COST (IN SHILLINGS) OF A "WEANER"

Year	*Cost*
1931–32	17·71
1932–33	14·72
1933–34	16·36
1934–35	15·51
1935–36	15·98
Average	16·05

TABLE VI.—COST (IN SHILLINGS) OF REARING A PIG TO WEANING AGE

ITEM OF COST	1933–34	1934–35	1935–36	*Average* (1931–36)
Food	10·61	9·96	10·47	10·75
Labour	3·42	3·45	3·38	3·29
General Expenses	0·04	0·12	0·01	0·06
Appliance Depreciation	0·97	0·55	1·05	0·86
Establishment Charge	1·32	1·43	1·07	1·09
TOTAL COST	16·36	15·51	15·98	16·05

In conclusion, it may be stressed that, in order to produce

cheap weaned pigs, three essential requirements must be met:—

(*a*) the breeding herd must be fed economically,

(*b*) a high standard of prolificacy must be set and maintained by the use of good boars and sows which farrow and rear large litters regularly, with the immediate elimination of any which fail badly in this respect, and

(*c*) the pig unit must be so organized as to make most use of the available labour.

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LIGHT FROM WIND-POWER

C. A. Cameron Brown

The wind is one of the earliest sources of power, and the possibility of its use is still a subject in which a lively interest is taken. The idea of "free power" is attractive, and it is therefore sometimes difficult to appreciate that the biggest limitation to is use is not technical but economic difficulty. It is natural to think of wind-power for generating electricity, but in this respect the economic limitations are serious. The position is analogous to that of water-power-generated electricity, where the overhead charges due to the expensive civil works required very often cancel the advantage due to absence of fuel costs. Although wind is free it is capricious, and if any planned use of power is contemplated, there must be some form of storage against not only completely calm periods, but also against periods when the wind-speed is too low to afford the power required at that moment. The vast majority of our modern uses of power are planned to more or less definite times and amounts and it is the overhead cost of making some storage provision which puts wind-power at such an economic disadvantage.

There are those who maintain that a windmill electrical plant can be run with no storage or reserve arrangements, but this entails in a calm such a dislocation of any working programme as to be impracticable. Others maintain that, by making the whole plant large and elaborate enough, the overhead costs for reserve sink in proportion to the output. This appears to be the basis on which large plants are being planned in Germany and Russia, one of the methods of reserve being to make and store hydrogen to produce in turn power by hydrogen engines. No definite evidence is yet to hand about the practical success of these large plants and they must be considered as no more than ambitious, if not fanciful, projects. Hitherto, success with windmill generating plants has been confined to the type in general use here, where the

wind-driven dynamo charges a battery, which is used to supply loads in time of calms or insufficient winds.

It has been natural that farmers should take particular interest in the possibility of using wind-power for supplying electric light, since from time immemorial the wind has been used for grinding and for supplying water. In very many instances this interest has been directed along the technical aspects of the problem and it is felt that some discussion on this side may be appreciated.

In considering the technical aspects of power from the wind, it must be recognized that for practical advantage the motion of the wind should be in one general direction for appreciable periods at a time. Wind must also be visualized as possessing mass and velocity. The absolute energy present in the wind at any given speed cannot be calculated without a knowledge of the height and breadth of a particular belt of air in motion, but a calculation of this kind would not have much practical significance. It is practicable, however, to calculate the energy available over a given area in a vertical plane at right angles to the direction of the wind, this being kinetic energy. The final formula is based on a barometric pressure of 760 m.m. and air as 0.08 lbs. per cubic foot and gives the power *available* as

$$\text{H.P.} = 0.00000226 \text{ A } V^3$$

where A is the area considered in square ft., and V is the wind-speed in ft. per second. The power available to drive a windmill can thus be calculated where A is the total frontal area presented to the wind by the whole circle of the wind-wheel, and V is reduced from the more usual way of reckoning wind-speed in miles per hour. The significant thing about this power formula is that the power increases with the cube of the wind-speed, so that a wind blowing at, say, 20 m.p.h. contains eight times the power of a wind blowing at 10 m.p.h.

The wind-wheel converts the power available over its frontal area to mechanical power at its main axis or axle shaft. The percentage of this total energy so converted to mechanical energy is a measure of the efficiency of the wind-wheel as an energy converter. One would naturally expect this conversion efficiency to be less than 100 per cent., but the practical limit to this efficiency is in fact much below this figure. To appreciate this factor it must be realized that the energy in the wind—in the moving air—is due to its

velocity, and that to extract all its energy, i.e., to achieve an energy conversion of 100 per cent. would necessitate depriving this air of all this velocity. But in order that the whole operation shall not come to a standstill there must be enough velocity left in the air as it leaves the wheel to carry it away from the wheel and so to be absorbed into the general wind-stream; thus, if a continuous power transfer is to be achieved, it is impossible to take all the velocity from the wind. It follows then that all the energy represented by the formula cannot be utilized, and it has been shown by Betz and Bilau that the maximum possible efficiency for a wheel is about 60 per cent. and that in practice the efficiency is below this. The true aerodynamic efficiency is the ratio of the energy extracted to the maximum theoretical efficiency, but it is more general to express the efficiency of a wind-wheel in terms of total energy available, i.e., in terms of that expressed by the formula.

There are three main types of wind-wheel:—

I. Horizontal wheels on a vertical axis.

II. Vertical wheels on a horizontal axis with the plane of rotation parallel to the direction of the wind.

III. Vertical wheels on a horizontal axis with the plane of rotation at right angles to the direction of the wind.

Types I and II are not familiar as windmills, but an example of the principle is seen in the cup type anemometer where four hemi-spherical cups are carried at opposite ends of the two main cross-arms. The disadvantage of this type of wheel as a power unit is that only a small part of the wheel at a time is doing useful work and, in fact, there is a loss of power due to pressure on the backs of the cups entering against the wind. Type II can hardly be conceded any advantages at all, but Type I has an advantage in being independent of the direction of the wind; on the other hand the average linear speed of the blades cannot be greater than wind-speed and so the rotational speed is limited. One wheel of this type is the Finnish Savonius wing-rotor, which may be likened to a vertical cocoa-tin, bisected vertically and with the two halves slid across each other until their concave sides just overlap; this enables the wind-stream to act to a certain extent on the concave sides of both blades at once and thus partially to eliminate one of the main disadvantages of this type of wheel.

Type III with a vertical wheel facing the wind is the most

familiar. This type of wheel has a set of blades fixed symmetrically and radially round a central axle that is set just sufficiently out of the horizontal plane to allow the wheel to lie back a little from the vertical plane. Each blade is itself inclined at an angle to the wind so that there is a resultant pressure in the direction of rotation. This type of wind-wheel has two outstanding advantages over the others:—

(1) every blade is receiving and utilizing wind-pressure simultaneously,

(2) as the direction of movement of the blades is not that of the wind, the linear speed of the blades can be greater than wind speed.

The first advantage results in higher efficiency and the second means a high rotational speed which is an advantage in driving rotating machinery, particularly an electrical dynamo which must be driven at a fairly high speed.

By wheel speed is meant the linear speed of the tips of the blades and is generally expressed as a ratio to wind-speed and indicated by " u "; thus, a large diameter wheel will run at fewer r.p.m. than one of smaller diameter for a given value of " u." In practice " u " varies with different types from about 1/1 to 6/1.

The importance of efficiency as applied to wind-wheels is apt to be over-estimated. Efficiency is generally the measure of the useful work obtained from the fuel or energy put into a machine. With the windmill, however, the input energy is free and it may be cheaper to have a large and relatively inefficient but cheaply constructed wheel than to have one highly efficient but costly to produce. In practice, the factor of mechanical efficiency does not play a very important part and the use of a form of wheel or blade is generally decided more by considerations of weight, speed and quietness. Indeed it is difficult, in assembling and mounting, to avoid introducing extraneous parts which spoil the efficiency of a carefully designed blade.

Considering type III, then, there are three main classes of wheel which may be conveniently described as:—

(*a*) Windmills—the form most generally known as the Dutch mill, with its broad sweeps of cloth-covered or wood-slatted construction.

(*b*) Wind turbines—multi-bladed wheels of metal, mounted on lattice towers and often called the "American" mill.

(*c*) Windmotors—less well known but gracefully bladed wheels with two or four propeller-shaped blades: they are sometimes called " streamlined " or " propeller " wheels. In theory these blades are designed to correct aerodynamic principles and values, but in practice this is widely departed from and they only retain a general resemblance to true aerofoil form.

It is regrettable that class (*a*) is more familiar to us as a picturesque, but static and too often incomplete, feature of local landscapes than as a power unit, since few things at work combine better the beauty of motion with the benefits of utility. Class (*b*), the American mill, has earned an unfortunate reputation as the unsightly and noisy successor to class (*a*) which quite belies its real merits as a very valuable power unit. Class (*c*) is mainly a post-war product and has been developed mainly for generating electricity, for which it is essentially suited, and is still so rare as to excite comment when seen. In appearance it is a distinct improvement on class (*b*) and indeed, when suitably mounted, it adds a touch of grace to the landscape hardly less attractive than the more solid dignity of the big sweep mill.

These types of wheel differ from each other in performance. In the first place their speed ratios differ. The wind-turbines are known as slow-runners with a tip speed-ratio " u " of from about 1/1 to 2/1. The windmills are medium-speed running about 2/1 to 3/1. Wind-motors are fast running with a value of " u " from 4/1 to 6/1. Thus for a given size of wheel the wind-motor (class *c*) will run at a much higher rate of revolution than either of the other two. It must be realized, of course, that a badly designed wind-motor or propeller may fall into the same class of speeds as the windmills. The efficiencies of these three types of wheel also differ. Whereas a good specimen of wind-motor will show an efficiency of as much as 42 per cent., a good windmill will hardly use above 33 per cent. or so, and a good sample of wind-turbine may reach 22 per cent., but not much more. These figures are the optimum in each class and will rarely be reached in practice. This is particularly true of class (*c*), and the practical tendency to curve these blades to nice proportions by eye rather than by aerodynamic consideration is likely to make this class little better on the whole than the windmill class.

Finally the working characteristics differ. The American mill, class (*b*), has a high starting torque, the wind-motor class (*c*), has a poor starting torque, and the windmill, class (*a*), comes somewhere between. This means that (*b*) can start up against a dead load, which conforms to its most useful job of pumping, (*a*) can start against a partial load and have the full load applied gradually, which conforms to its most usual task of grinding, and (*c*) requires to have practically no load until it is moving fairly quickly, which conforms to its most suitable job of driving an electrical generator. There is no particular rule governing the number of blades. A larger number of blades will improve the starting torque and a smaller number will increase the optimum working speed, but provided that the gear ratios are chosen to suit, there is little difference in power. For instance, in the streamlined type of wheel the best efficiency is obtained by a three-bladed wheel, but because of manufacturing difficulties it is more usual to find 4- or 2-bladed wheels. The former is slightly the more efficient, but it is cheaper to build a two-bladed wheel with about a 15 per cent. increase in diameter and so have the same power output when running at a higher speed.

It is largely then on the basis of the propeller type wheel that the modern windmill-driven generating plant is being developed. Realising the difficulties introduced when catering for a large power use, and the cost of reserves or standby, the British and American makers seem to be concentrating more on the smaller sets with outputs below half a kilowatt. Indeed, two British makers specialize in very small sets suitable for as low as 12-volt batteries, and in one of these makes a portable form is offered such as would be useful for exploration parties carrying a radio set. From time to time appeals are made for battery equipment for lonely islands—Tristan de la Cunha, the Falklands and so on—and one wonders whether the simple solution of the windmill set, which on windy islands would be ideal, has not been overlooked.

The British wind-figures for 1924-25 show that at one inland station for 57 per cent. of the time, and at a coast station for 41 per cent. of the time, the wind-speed did not reach 8 m.p.h., which is the practical minimum for windmill working if it is designed to make full use of the higher winds. The respective proportions for winds between 10-15 m.p.h., a very useful working period, were 18 per cent. and 24 per cent., and for

the very valuable winds between 15 and 20 m.p.h. the proportions were 9 per cent. and 16 per cent. respectively. It is therefore obvious that to plan a definite load throughout the year without having to worry about the variations in wind will require a very substantial reserve of power indeed and a plant which is most likely to be quite uneconomic. If large batteries are installed their first cost and depreciation are high; if a standby engine is installed, then one of the objects of using wind-power is lost straight away and it is indeed questionable whether it would not be economically better to use the engine alone. These considerations militate very heavily, not against the use of wind-power for generating electricity, but against the use of wind-power for generating electricity to any definite schedule or for a load which is inelastic and irreducible. There is, however, the possibility of its adoption within fairly wide limits for supplying country houses, farms, holiday bungalows, etc., with electricity for light and small appliances, where no great hardship is caused through having to be careful with the light for a night or two or to leave off ironing or vacuum cleaning temporarily.

The high proportion of time with winds below 8 m.p.h. need not be too discouraging. It is not so much the total of low winds and calms that matter as their distribution. If such periods were distributed evenly over the whole year, then one could expect each day a certain amount of useful wind and there would be no drawback to using wind-power. In actual practice, the position is not generally so good as this and sometime during the winter one may expect a foggy calm of from two to five days on end in the inland meadow land areas. Those living on or near the coasts or hilly lands know, of course, that even this is not very likely and that there is almost every day some appreciable movement of air.

It should not be thought for a moment that any windmill electric installation within the reach of a farmer is likely to afford a service even distantly approaching that from a main supply line. Until this comes along, however, the windmill is one of the alternatives to be considered for at least an interim period. Even the humble 12-volt plant can be utilized to afford quite effective lighting.

The exact size of the plant depends on the load to be met and the wind conditions in the district. If winds are fairly reliable and calms are few and of short duration, the windmill plant can be smaller than if different conditions prevail. A

favourite size is an 8-foot diameter wheel driving a 250-400 watt dynamo. This should give an effective lighting supply for a farmhouse of up to, say, ten rooms and small farm-buildings, and a certain amount of use may be made of small appliances, such as a vacuum cleaner, iron, toaster, etc. If lighting alone is required, the voltage need be only 50 or even 25, but if appliances are to be used then a 100-volt battery should be fitted with a capacity of 100-150 ampere hours.

A 12-volt set can be obtained for as little as £10, and a ½-kw. 50-100 volt set for from £60 to £80; batteries are extra, a car battery being used with the 12-volt set, and for the bigger set a glass-cell battery costing from £50 to £100 according to voltage and capacity. An 8-ft. wheel, ½-kw. set may be expected to provide about 1,000 kwh. in a year, and other sets roughly in proportion to size.

Much of the effectiveness of small generating plants of any type depends on the layout of the wiring system with due recognition of the limitations of the system, i.e., just as when water pressure is low larger section pipes are fitted, so must larger section lines be used. Indeed, it is a wise thing to run a large-sectioned cable through the house, from which the local points may be wired off. In making the fittings, large ceiling pieces should be avoided: the light should be put in small units where wanted, and recognizing this, a humble 25-watt lamp in a standard fitting is generally ample. For passages, cellars, larders, etc., certainly nothing larger and preferably something smaller than 25 watt lamps should be used. Whether in house or farm, it is advisable to have plenty of switches—one to each light—so that there need be no waste of lighting because several points are on one switch. The necessity for economy, especially regarding the use of appliances, will, of course, vary with the weather, e.g., towards the end of a long calm period some self-denial with the iron may be necessary—but while perhaps disconcerting at first, experience will show just what liberties with the system may be taken.

Finally it may be agreed that the modern propeller wheel, mounted preferably on a wooden tower is quite a bearable sight and is reasonably quiet when running. The small bulk of exposed material renders damage by storm very unlikely and the internal methods of speed governing are very effective.

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THE EDUCATIONAL AND RESEARCH SCHOLARSHIP SCHEMES OF THE MINISTRY—II*

Research Awards. One of the main problems facing the Agricultural Research Institutes is to find men of good calibre who have received a sufficient technical training. The object of the Ministry's Research Scholarships Scheme is to train recruits to meet this need, and it was with this in view that the Development Commissioners started a scheme of scholarships for research in agricultural and veterinary science 27 years ago as part of the general programme of agricultural research which has remained, despite important modifications, unaltered in principle down to the present day.

Under the scheme at present in force the Ministry of Agriculture and the Department of Agriculture for Scotland offer three classes of research scholarships, viz., Agricultural Research Scholarships, Studentships in Animal Health, and Veterinary Scholarships. These scholarships and studentships are offered by the two Departments on the advice of the Agricultural Research Council. No conditions are imposed on the nature of the subsequent work the holder takes up after the termination of his scholarship or studentship, and no guarantee of subsequent employment at the termination of the scholarship or studentship is given.

The holder of a research scholarship or studentship must engage in research work under prescribed supervision at institutes approved by the Ministry on the advice of the Agricultural Research Council. He (or she) is expected to put forward a research programme for his period of study on such subjects as soils, plant physiology or pathology, animal or plant genetics, animal health, etc. The only condition is that the Ministry's approval must be given for the student's programme.

The whole time of the holder is devoted to the approved programme. He must not hold any salaried post during the

* Part I of this article appeared in the June issue.

tenure of this scholarship or be in receipt of any remuneration other than that provided by the scholarship.

(i) *Agricultural Research Scholarships.* Not more than four of these scholarships are usually awarded during each academic year. Their value is £200 per annum, and, where necessary, an additional allowance of a sum not normally exceeding £50 per annum is made for fees compulsorily incurred and for other approved expenses, such as travelling. Candidates must be graduates with honours in science at a British University or with similar qualifications.

The scholarships are tenable for not more than three years. In the normal way, the first two years are spent in a British Institute and the final year at a foreign Institution under the supervision of some recognized authority on the scholar's particular subject. During any period of travel abroad the student receives an additional travelling allowance to cover the increased programme of work.

(ii) *Studentships for Research in Animal Health.* Every year not more than three studentships in Animal Health of an annual value of £300 inclusive are awarded. Preference is given in the awards to candidates with a veterinary or medical qualification, but a candidate who has graduated with honours in a science connected with the subject of animal health, such as zoology or bacteriology, would also receive consideration. As with scholarships for agricultural research, studentships in animal health are for not more than three years and the student may be required to spend part of his time abroad.

(iii) *Veterinary Scholarships.* In place of one of the Research Studentships in Animal Health, a Veterinary Scholarship of the value of £300 per annum, with allowances not exceeding £50 per annum, and tenable for not more than four years, may on occasion be awarded to enable a graduate with honours in science to obtain a professional veterinary qualification, with the eventual object of undertaking research in animal diseases. Awards of Veterinary Scholarships have hitherto been exceptional. The scheme was brought into being in 1936 because there was a dearth of men with professional qualifications who wished to undertake research work, and it was realized that without these qualifications a pure scientist would labour under a disadvantage.

Awards are on a sufficiently generous scale to meet

all reasonable expenses of the student; and during any period of travel abroad the student receives an additional maintenance allowance to cover the increased cost of living and travelling expenses.

(iv) *Travelling Research Fellowships.* In conclusion, a note should be added on a scheme closely connected with the research scholarship and studentship schemes. A small sum is set aside from the Development Fund for grants to enable established research workers to travel and to examine at other centres the work that is being accomplished on problems with which they are concerned.

Awards have in the past been made to enable such specialists to travel abroad with a view to their gaining insight into methods of work on subjects in which they are personally engaged or to their carrying out work in a particularly favourable milieu. Grants are also made under this scheme to enable research workers to attend international conferences. The value of this scheme needs no labouring; it affords a useful opportunity for research workers to take part in discussions on topics connected with their work and to make contact with prominent research workers in other countries.

PLUM GRADING

J. W. EWAN,
Ministry of Agriculture and Fisheries

When discussing this matter with growers, one is struck by the sharp division of opinion expressed; those who have attempted a system of grading are convinced that it pays, and ridicule any suggestion that there is nothing in it. On the other hand, many of the bigger growers plead that with such a huge bulk of perishable fruit to handle, as they often have, any attempt at grading is impossible.

With the above in mind, the writer has, for several seasons now, examined consignments of plums on all the important West Midland markets and also received reports from other markets that handle plums from the West Midlands. From the information thus obtained, it is clear that the majority of the consignments are "topped," some in a grossly deceptive manner, and a less proportion in a more respectable fashion, but nevertheless "topped." The wholesaler complains about this with little or no effect on the offender. Where certain growers grade and use a suitable package it is also clear that their fruit sells first and usually makes a much better price than the ungraded sample, and still more important, the retailer enquires of his wholesaler when these growers will be sending in their graded fruit again. Retailers must buy perishable fruit quickly, and early in the morning, and if they can trust a mark of some sort or another they are saved much trouble and expense. Undoubtedly, there are times when a graded sample makes very little more than a reasonably good ungraded sample, but this is the exception rather than the rule, and is due to some unusual condition on the market. Especially is this sort of thing liable to occur on an auction floor where a buyer may have an urgent 'phone call for further supplies of a certain variety of plum, after the graded fruit has been sold, and because he is anxious to secure this supply he may pay more for some inferior ungraded sample. With this in mind, it is not intelligent to compare one day's results of prices obtained for ungraded and graded fruit. The only way to get any sound information is to compare prices over a whole season, and so far, from returns growers have kindly

allowed me to examine, the price level has always shown an advantage to a greater or lesser extent in favour of the graded fruit, even in a glut season. Thus, one concludes that if a method of grading can be devised that can deal both adequately and economically with a large bulk of plums, then it would be foolish not to grade.

Method and Cost. From practical experience during the past three of four seasons it would appear that, to make grading economic, the first thing required is a crop of reasonable quality; a very bad sample is not worth grading. Trees should be carefully sprayed in the winter, and where possible, thinning should be done when the crop is too heavy, or, only the good fruit out of a big crop should be marketed, the real rubbish being destroyed.

Having produced a plum of reasonable quality, there are two main methods of grading that present themselves:—

(1) The use of a mechanical sizing machine with grading belt attached.

(2) Picking over by hand direct into containers, from a moving belt, or a stationary table.

(1) Mechanical sizing machines are not yet all that could be desired, but improvements are being made every season. The more modern types remove much less bloom than the earlier machines of a few years ago. The output of sizing machines has come in for much criticism, but here again it is felt that this can be improved tremendously.

Despite the disadvantages mentioned above, such graders have been successfully used, and even with a small amount of bloom removed, the fruit has shown a very good monetary return.

Two growers, each using a different type of plum grading machine, very kindly furnished their market returns for 1937, and from these the following figures have been calculated. It is of the utmost importance, when studying these figures, to bear in mind that the returns shown represent the average price returned for the whole crop of plums, not merely those graded into "firsts," but "seconds" and "over-ripes," etc., etc. So that the total sum of money received by the grower for the whole of his crop is represented by the average per 12 lb. chip, multiplied by the weight given. The average price for ungraded samples for comparison has not been calculated because no sound information of this is

available. However, growers will be able to compare this price level with their own obtained in 1937. It might be added that grower "A" commenced marketing his "Rivers Early Prolific" on July 23, and continued through the season without a break with his other varieties, the last consignment being "Pond's Seedling" marketed on September 10.

Grower "B" commenced marketing his "Victorias" on August 20 and finished on September 17; thus the returns given cover falling as well as rising markets.

GROWER "A"

Variety	*Weight*	*Average Return per 12 lb. Chip* s d
Rivers Early Prolific	3 tons	3 5
Belle du Louvain	10 ,,	2 2¾
Victoria ..	13 ,,	2 3
Pond's Seedling	5 ,,	2 1
Cox's Emperor	4 ,,	2 0
Pershore Yellow Egg	12 cwt.	0 6

GROWER "B"

Variety	*Weight*	*Average Return per 12 lb Chip* s. d.
Victoria	6½ tons	2 6

The cost of grading with a mechanical sizer is put down by one grower as 8*s*. 4*d*. per ton, but from practical experience obtained during the past few years, I should put it at 6*s*. per ton made up as follows, and allowing 2 hours as the average time to grade 1 ton:—

	s	d.
Labour—		
3 girls, 2 hours each at 6*d* per hour	3	0
2 men, 2 hours each at 9*d* per hour ..	3	0

No allowance has been made for depreciation of the grader, or power for driving the machine.

It is clear that the cost of grading and sizing will vary considerably; so much depends upon the quality of the plum handled, and also upon the perfection of organization built up by the grower. However, it is clear that only a small margin of increased return is needed to pay for the cost of grading.

(2) Picking over from a moving belt, with girls on either side, or from a stationary bench or table can be satisfactory, and certainly damages the plum less than a machine.

A grower who adopted this method allowed me to examine his market returns and these analysed showed the following result. Marketing commenced on August 21, and finished on September 4.

Variety	*Weight*	*Average Return per 12 lb. Chip* s. d.
Victoria	4 tons	2 10

It is important when grading is considered to bear in mind that one must go the whole hog if a satisfactory result is to be achieved. It is useless grading out a good sample of fruit, and then packing it badly and in unsuitable containers. There is a tendency nowadays to use smaller packages for plums, and in the writer's opinion this is sound, and for an " Extra Selected," or " Selected " grade of plum, nothing larger than 6 lb. is desirable, while for the former grade 4 lb. and even 2 lb. can be used with advantage. One or two growers have used a flat tray holding 6 lb. of plums; this appears to be admirable, most of the fruit can be seen without handling, and the bottom plums are not crushed by any weight of fruit. A good " mark " should also be considered, a cover or label with a distinctive, yet pleasing appearance, can help the sale of fruit more than most growers realize; this will advertise the fruit far better than the everlasting blue and white print usually associated with chip covers in the West Midlands.

If the above suggestions are put into action, and then poor fruit put into such containers, the grower's name will become distasteful to the wholesaler—and rightly so. The writer has been amazed at such attempts of fraud—as fraud it is—made by growers whom one would have thought far above such short-sightedness.

The last important question to decide is—Where shall I send this carefully graded product? The answer is—To the man who knows how to sell it, and not carelessly to anyone who professes to be a wholesaler. In every market there are those who are specialists in the sale of this or that fruit or vegetable, and it is for the grower to tour the markets and note where the best fruit is being sold, and that obviously will be the place for good fruit, because retailers who want good produce will make straight for the man who usually sells it. There are also some small markets where the buyers are not educated up to graded produce, and do not appreciate such consignments; in such markets all your energies will be

wasted. The best buyer will go to the best salesman in the best market to buy the best fruit.

Now what of the " smalls " and " seconds," etc. ? These should be marketed in larger packages, 12 lb. chips, or 24 lb. sieves, and sold in the markets that attract the buyer who wants that class of fruit. There is no need for elaborate packing, or an attractive label, but even here " topping " should be eliminated.

In connexion with the mention of a " mark," why could not a number of growers agree to market their " Extra Selected," and " Selected " plums under a county " mark " combined with the National Mark. The fruit could then be advertised with safety, and the public would associate good quality with the county. The grower's name, or brand, would, of course, also be shown on the label. The success of apple marketing associations in Essex and Kent, which have adopted this principle, indicates what can be done in this direction. I am aware that a plum can hardly be compared with an apple, one being extremely perishable and the other not; however, I believe the principles of these associations could be applied with success to plum marketing.

In conclusion, it would be well to remind growers that the National Mark Scheme was altered two years ago, after practical experiment had shown that the original grade was not altogether suitable. Experiments with the new grades have demonstrated them to be easy to work and suitable for all varieties of plums. Provision is now made in the Scheme for two grades, namely " Extra Selected " and " Selected," the former to exclude the largest and best fruit, the latter to include the bulk of really good quality fruit. The size definition of the " Selected " grade, the only one previously defined under the Scheme, has in the new regulation been slightly increased.

JULY ON THE FARM

R. W. WHELDON, D.Sc.,
King's College, Newcastle-upon-Tyne

Most welcome rain has fallen in all parts of the country since the time of writing the June notes, and the marvellous change in the appearance and general condition of the crops affords an excellent illustration of how dependent crops, and in turn farmers, are on weather conditions. A marked change is seen in all cereal crops where sufficient plants had survived the dry period. Unfortunately, in many places there had been a high mortality amongst seedling cereals and a very thin and patchy plant remains. Haymaking has already started in the earlier districts, but the crop appears to be very light indeed. In the later districts, especially on meadow land, there is more time for growth, but in the main the outlook for the hay crop in most parts of the country is by no means good.

In a season like the present the farmer is often in doubt whether to allow the crop to stand longer than usual before cutting in the hope of getting a little more weight or to make sure of the quality and sacrifice the quantity. This year the decision is not an easy one, as it may well happen that, if there is a reasonable amount of growth of bottom grasses, this may counter-balance any deterioration in feeding value that may take place in those plants which are further advanced. It has often been pointed out, however, that permanent meadow plants that have been allowed to mature are not likely to be so vigorous in the following year.

It is interesting, under present conditions, to compare the differences in the leafy strains of ryegrass and cocksfoot as compared with the commercial types. The leafy types have not shown the same tendency to send up flowering stems during the dry weather, but it is doubtful if they have produced the same rapid response to the moist growing weather as the commercial types.

In the Notes of last month silage was referred to as a possible supplement to ordinary food supplies during the coming winter.

Should the late summer be particularly favourable to the growth of grass, the cutting of aftermath for silage might well be considered. Sometimes farmers are disappointed with silage as a food even when it is well made, but in such instances the fault usually lies with the quality of the green material. Good feeding material can only be taken from the silo by putting good feeding material into it. The best that can be looked for in the making of silage is to conserve a large part of the food material of the fresh green material used—it cannot add to it.

Cattle. The improvement of pastures will greatly help all grazing stock. The pasturage available will, in many instances, consist entirely of very young grass, which normally has a high feeding value and is particularly rich in protein, the effect of which may be to produce a laxative condition. With fattening cattle, particularly those well forward in condition, undue laxativeness limits the rate of live-weight increase. To some extent this may be corrected by feeding a carbohydrate food, such as maize, or a binding food like undecorticated cotton cake; on the other hand, purchased foods are expensive and the feeder normally does his best to avoid undue expenditure when suitable pasturage is available. What decision is taken should depend on the quantity of grass available. If there is anything to be gained by restricting the amount of grass consumed, then the expenditure on concentrates may be justified, while if there is a surplus of grass it would probably not be an economic proposition to spend money on additional feeding. After cattle have been some time on rich young pasturage with little fibre, they will often relish and consume with advantage clean oat straw or hay. This is usually an advantage to the animals if they take it readily.

Milking cows are responding to the improved grass, but it usually happens that the value of grass for milk production begins to fall off during the present month. Even if the milk supply is sufficient to meet requirements, an abnormal fall in the general yield should be avoided as the loss can never be fully recovered when needed. It is good policy to maintain high production from the more recently calved animals, as a falling off in yield early in the lactation means a much greater loss than if it occurs towards the end. The policy should be to allow animals nearing the end of the

lactation to fall away rather than those which have a longer period to go.

Considerable numbers of breeding cows are allowed to suckle calves that are intended for beef production. They too have responded in increased yield of milk, and calves already show signs of making better gains. In September and October these calves are usually weaned. It is most desirable that the change to hand feeding should be gradual. Often calves are weaned without having been taught to eat trough food, and these lose a considerable weight before settling down to the changed diet. It is advisable to teach the young animals to eat concentrates while suckling, and better gains are secured in the months of August and September if the calves are getting some concentrates when their food requirements are increasing and the supply of milk is getting less. Where practicable, the calves may learn to eat cake with their mothers, and once they become accustomed to it they can be fed apart through a creep. A better gain is usually obtained in this way and a check at weaning time is avoided.

Sheep. The first lamb sales take place during the month, and flockmasters all over the country will be anxiously awaiting the results of these early sales, which give an indication of the tone of the market. Two factors have a great influence on the price of store lambs—first, the current price of mutton and lamb, and secondly, the probable quantity of keep available. Present fat prices are not very encouraging, but autumn grass may be plentiful, and while it is early to forecast in relation to the root crop, the prospect is at present fairly good.

July and August are both bad months for maggot; good shepherding and dipping when necessary can do much to reduce the losses from this pest. Very great loss can be sustained in a flock apart altogether from deaths. The shepherd, too, knows how much work is involved if the trouble is not brought under control in the early stages.

Draft ewes are often drawn out during the month. Amongst hill breeds and half-bred flocks it is the usual policy to draft out according to age. In pure breeding flocks of any kind it is desirable to retain as long as possible the best females. Type, prolificacy and milking qualities are valuable characteristics, and any animal that has proved

its capacity to hand them on to its offspring should be retained as long as possible. The choice of the ram is an important matter, but, however good a sire may be, the best results can only be obtained when he is mated to good females.

Weeds. Local authorities at this season of the year take steps to enforce the Injurious Weeds Order. Compulsory destruction of weeds is enforced not only to protect the farmer on whose land they grow, but also his neighbours. The seeds of plants included in the Order may be carried by birds or be wind-borne and deposited at considerable distances from where they are grown. The total loss to agriculture by weeds of various kinds must be very considerable, and efficient steps to rid land of them are to be commended. Crops are always reduced where weeds are present, and inefficient cleaning means that the work has to be done again the following year, and so the labour cost may go on indefinitely. The Ministry's Bulletin dealing with weeds of arable land, their control and eradication, is obtainable for 4s. (see p. vi), and gives most useful information as to the best means of dealing with the different classes of troublesome plants.

The creeping thistle, one of the most common weeds on pasture land, is later this year than usual and pastures have not yet taken on the unsightly appearance which marks them when this weed is present. Close examination even now shows that they are present, and early cutting is recommended. Late cutting may do little good if the plants have been allowed to store up food for future growth. Where they have been cut already, a second cutting of any growth that may take place is advisable, as this reduces the vitality and may even kill the plant.

Potato and Root Crops. Soon after the rain, land that appeared to be clean and free from weed became covered in many instances with thousands of young seedlings—chickweed, fat hen, charlock, etc. With good drill cultivation, however, it has been possible to keep these in check. Drill cultivation has been most important, not only in controlling weeds, but also in maintaining tilth and favourable soil conditions for the crops. The benefit of drill cultivation has been most obvious with potatoes and roots this season. Heavy rain tends to form a " brat " or crust on the surface, which

prevents aeration, and drill cultivation with horses and hand hoes maintains a surface mulch and keeps the roots of the plant going with air and moisture.

In many places, the singling of root crops is well forward. Singling competitions have taken place in some areas. These competitions seem to be most popular in Scotland and the north of England, and are useful in encouraging good workmanship. In the main, roots are the best plant on the lighter soils where tilth was readily obtained. On stronger soils, the chief difficulty lies in getting enough tilth to germinate seed and establish the plant. If a good tilth is obtained, and a plant once established on strong land, a crop is generally assured. The effect of dry weather may be serious on light soils later in the growing season, but on strong soils the crops are less likely to suffer.

Agricultural Shows. The season of agricultural shows is with us again. When these Notes appear the chief Scottish event will have passed, and the stage will be set for the Royal Agricultural Society of England's show at Cardiff. These shows are most valuable in that they set a standard for livestock, and the machinery sections embrace every kind of device that the human mind has been able to invent to assist the farmer. The up-to-date farmer can scarcely afford to miss the educational opportunities afforded, and it is interesting to see how much time the modern farmer spends amongst the implement and machinery exhibit—it is obvious that it is a real live business interest that he takes in complicated machines, an interest that, a few years ago, no one would have associated with the farmer.

AGRICULTURAL MACHINERY TOPICS

S. J. Wright, M.A.,
Director, Institute for Research in Agricultural Engineering, Oxford

Overhead Irrigation. During April and May several ingenious attempts at watering ordinary farm crops were described in the agricultural Press. In one instance, the local fire brigade was called into service; in another, an old lorry was geared to run at a very low speed carrying spraying equipment fed by a trailing hose. But, whatever the actual method used, each was clearly only an attempt to deal with emergency conditions arising from an exceptional drought; and, since the drought has now broken, most people will in all probability forget that such an emergency is ever likely to arise again. Among fruit and vegetable growers, however, permanent overhead irrigation equipment is receiving more attention each year, not only on highly intensive holdings devoted to what might be called " luxury crops," but also on larger holdings where small acreages of fruit and vegetables are combined with ordinary farm crops. Incidentally, it is claimed that the advantages of irrigation are by no means confined to periods of exceptional drought but that, with some crops at any rate, it is definitely profitable even in an ordinary season to be able to apply the equivalent of a good shower of rain just when it is wanted.

The equipment used is " permanent " only in the sense that it is always available: it is not fixed and, provided only that water is available somewhere near at hand, it is not restricted in any way to one particular part of a farm. It consists of a pumping outfit, which is generally portable, a sufficient length of supply pipe to reach from the source of water to the site where it is to be used; and some means of distributing the water over the crop. The latter is the most important part of the equipment, for, since the greater part of the cost of irrigation is involved in getting the water to the site, it is clearly good economy to take great pains over distributing it efficiently. One obvious requirement is that the water shall be put on uniformly. Another, according to the

experts, is that it shall be put on fairly slowly and in such a way that it reproduces, as nearly as possible, the generally humid atmospheric conditions that exist when rain is falling.

The most usual—and presumably the most effective—equipment is the oscillating spray line. It consists of a pipe of 1½ or 2 in. diameter, provided with jets at intervals of about 2 ft., and carried about a foot above ground level on a series of small tripod stands. When in operation the pipe is rocked to and fro through an angle of about 90° by an oscillator, which is operated by the water itself as it passes from the supply pipe to the spray line. Each jet is thus constantly moving so that all the ground within range is watered uniformly while the whole area is covered with something rather like a coarse mist. The spray line may be up to 200 yards in length and is made in short sections—each provided with a tripod stand and with quick-coupling connections for attachment to the other sections. The total lateral throw of the spray line is about 14 yards and is practically independent of the water pressure, provided that the latter is between 25 and 50 lb. per sq. inch. A 200-yard length therefore covers rather over half an acre at a time. The quantity of water put on varies with the size of jets, but is usually from 1,500 to 3,500 gal. per hour for a 200-yard line. With the largest jets, the equivalent of an inch of rain can be put on in about three hours.

The cost of a 200-yard spray line with oscillator is round about £50. To this must be added the cost of the supply line, which is usually ordinary iron water-pipe with quick-coupling connections, and of the engine and pump outfit. The latter need not be very expensive for in at least one instance an old car has been adapted for the purpose.

The way in which irrigation is used in practice varies with circumstances: it may, for example, be used to promote germination; to save a crop threatened by drought; or to wash in a dressing of artificials. Whatever the purpose, however, the amount of water actually applied at one time is generally equivalent to from a quarter to half an inch of rain. The area which the ordinary type of spray line can deal with effectively is clearly limited by the necessity for uncoupling the individual sections when moving the line sideways to cover a new area. In one particular type of equipment introduced this year a new system of support has been adopted that enables one man to keep the line in practically continuous operation without

any uncoupling between shifts. No detailed particulars are available, but it is clear that, if successful, the innovation will greatly increase the possibilities of irrigation on something like ordinary farm scale.

Harvesting Economies. According to a recent estimate, 115 combine harvesters were at work in this country during the 1937 harvest—the tenth harvest since their introduction. According to the point of view, this figure might be regarded as an indication that combine-harvesting has come to stay, or, alternatively, that the process is never likely to be used to harvest more than a rather small fraction of our total grain acreage. On the other hand, even if we accept the latter conclusion, it seems unlikely that two such utterly opposed processes as combine-harvesting, with its attendant grain drying, and the older business of cutting, stooking, carrying and stacking, can continue to exist side by side as the only two methods of harvesting appropriate to our conditions. And in point of fact, the growing tendency to thresh grain more or less straight from the field is an indication that a suitable compromise is being sought, although this modification by itself does not achieve any great saving of time, money or labour. More interesting are the attempts that have been and are being made to eliminate labour from the harvest field itself. One of these, the reaper-elevator, which was in effect a binder with the binding mechanism replaced by a direct-loading elevator, was unsuccessful because the loose-cut straw produced a "fluffy" uneconomical load on the trailer and also made threshing difficult. A similar type of device with the binding mechanism retained so that sheaves and not loose material could be loaded might be more successful but, so far as the writer knows, has not been tried. In another idea which has never got beyond the experimental stage, an ordinary binder was fitted with an extra cutter bar, which removed the heads of grain, and a device for loading them into a trailer; the straw being bound and dropped in the ordinary way. Again, some farmers have tried sweeping either stooks or the loose cut material direct to the rick or threshing machine and, particularly when stooks are swept as a whole, have found the method reasonably successful. A more practical solution for general use, however, is likely to result from the sheaf-loading devices which several farmers in different parts of the country are evolving for themselves.

One successful example consists essentially of an adaptation of a standard type of elevator which is driven by a small engine and can be hauled by a tractor alongside an ordinary wagon. It will load either stooks, or sheaves lying as the binder leaves them, and with three men in all—one on the tractor and two on the wagon—can put up a full load in under ten minutes. As used with ordinary wagons, it was estimated to save at least two men at carrying time. In the future the same device is to be tried with a high-sided trailer coupled to the tractor by a telescopic hitch which will enable the sheaves to be dumped first at the back and then at the front so as to get a reasonably even load without any hand labour at all. Such a device has the obvious advantages that it involves relatively little capital expenditure and that, according to the season and the crop, it can be used with or without stooking and for either stacking in the ordinary way or immediate threshing.

Charcoal Gas Producers. While the *Salon de la Machine Agricole,* which was described in the May JOURNAL, was in progress, the French Ministry of Agriculture staged in an adjoining building a very comprehensive exhibit of producer-gas appliances. Great efforts are being made in France to encourage the use of charcoal gas producers, not only in agriculture, but for road vehicles of all kinds. Privately-owned vehicles that run exclusively on charcoal gas are entitled to a remission of all ordinary taxation, while from next year onwards, public transport authorities will be compelled to run a gradually increasing proportion of their vehicles on this home-produced fuel. It is clear, therefore, that charcoal-burning plants are now regarded as being thoroughly practicable for ordinary use.

The Show exhibits included motor cars, lorries and agricultural tractors—all adapted to run on charcoal gas from producer plants carried on the vehicles themselves. In some of the motor cars the various components of the equipment were so cleverly fitted into what would ordinarily be the luggage boot and in other concealed places that external examination revealed nothing unusual at all. On the lorries the equipment was fitted either between the cab and the front of the body, or beside the bonnet in front of the cab, and was thus plainly visible, although it would not interfere in any way with the normal working of the vehicle. On the tractors

—due to the absence of anything resembling a chassis—the gas producers were less neatly arranged; in fact, their appearance suggested that they might sometimes interfere with the use of the machine with row-crop or other directly attached equipment.

In this country, charcoal is not readily available and any similar attempt to encourage the use of home-produced fuel would have to depend on anthracite. The differences between the fuels are, however, not very great and, given an equally efficient producer in each case, the results obtained with the one fuel should generally apply to the other. According to the many French tests that have been carried out, about 12½ lb. of charcoal (or anthracite) will replace 1 gal. of petrol. And if, for the purpose of a comparison applicable to agriculture in this country, we assume that the petrol is actually vaporizing oil at about *7d.* per gal., it would appear that producer gas should be the cheaper fuel so long as anthracite can be bought for less than £5 5*s.* per ton. On this basis, the user of producer gas should save, at present prices, rather more than half his fuel bill. This, of course, is not the whole story for, with ordinary types of engine, a straightforward conversion from petrol or paraffin to producer gas cannot be made without some loss of power, while the capital cost of the extra equipment must also be taken into account. Finally, the general convenience of liquid as opposed to solid fuels must also be considered. The loss of power resulting from a change to producer gas may amount to as much as 40 per cent., although, with a slow-running tractor engine, it should be possible to reduce this to negligible dimensions by suitable modification of compression ratio, valve timing and ignition. For one of the French charcoal-burning outfits the complete cost of conversion for a Fordson tractor, including the necessary modification of the engine, is given at 9,500 francs, or a little over £50 at the present rate of exchange. At this price the conversion would probably be economical enough to offset any ordinary loss of convenience.

NOTES ON FEEDING

Charles Crowther, M.A., Ph.D.,
Harper Adams Agricultural College

MILK SECRETION—II*

Variations in Milk Secretion. Milk is a mixture and therefore liable to variations of quantitative composition. These variations are the most pronounced as regards the fat, but occur with all the ingredients. As a rule, the proportions of protein and ash tend to rise and fall with that of fat, but within narrower limits.

The secretion of fat has been more extensively studied than that of any other milk ingredient, owing to its dominant influence upon the value of the milk for most purposes for which it is commonly used. The average fat-content of the milk of an individual cow is commonly regarded as an inherited characteristic, but it may be greatly influenced by factors of environment and management, and wide deviations from this average may be found at different stages of lactation and often within short periods. Variations occur between individuals and breeds, from milking to milking, from quarter to quarter, and even at different stages of the milking of any one quarter. No adequate explanation of these variations has yet been found, but they appear to be associated in some way with variations in the rate of milk secretion.

Variations in fat percentage are more closely correlated with changes in milk-yield than with any other factor. A lowering of milk yield from almost any cause is more often than not accompanied by a rise in fat percentage, whilst similarly a rise in milk yield will frequently mean a slight lowering of fat percentage. Where the fall in milk yield is abrupt and considerable the effect upon fat content may be correspondingly large.

There is a marked seasonal variation in the percentage of fat, the maximum occurring in the winter and the minimum in the summer months. This seasonal effect is complicated by other factors such as stage of lactation and change of dietary, but there is evidence that its primary cause lies in the difference of environmental temperature. Seasonal variations in the activity of the pituitary gland, which is known to have a potent influence upon the secretory process, may also possibly play a part.

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* The previous part of this article appeared in the June issue.

From one lactation to another there is no consistent change in the average fat percentage of the total output of the individual cow. The increase in milk yield that may normally be expected in the first four or five lactations is not necessarily accompanied by a fall in average fat percentage. As a rule, however, there is a tendency for a slight rise until the cow reaches maturity at 4 or 5 years old, and a rather sharper decline after the age of 6 or 7 years. The average found for the first lactation, if of normal duration, is commonly regarded as sufficiently characteristic of the fat-secreting capabilities of the individual to serve as the basis of selection. Certainly it is rarely that a cow which gives milk low in fat as a heifer will do much better in subsequent lactations.

Influence of Food Supply. Probably no aspect of milk secretion has been more extensively investigated than the influence of food upon the amount and nature of the fat secreted. Although, as explained in last month's Notes on Feeding (see pp. 280-285), the full development of the secretory potentialities of the animal is primarily determined by the nature and state of development of the mammary gland, the actual results obtained at any time may be very greatly influenced by the food supply. This influence is usually exercised more definitely upon the volume of the secretion than upon its composition. In view of the great variety of conditions that may affect milk secretion it is not surprising that the attempt to determine by experiment the specific effects of food upon milk yield and quality should have proved to be a problem of great difficulty, and that there should be some diversity in the results obtained. This applies particularly to the evidence as to the possibility of influencing the fat-content of the milk through the food supply. There is an overwhelming mass of evidence, however, to indicate that the fat percentage cannot be altered significantly over any extended period by varying the nature of the feeding stuffs included in the ration within the range of rations used in good dairy husbandry practice—rations, that is, which are reasonably "balanced" with regard to protein supply, and adequate in their provision of vitamins and minerals.

The only apparent exceptions to this generalization are the oil-cakes derived from palm kernels and coconuts, for which a good deal of seemingly reliable experimental evidence has been obtained on the Continent, indicating that their inclusion

in rations tends to raise the fat-content of the milk. The increases reported are mostly small, varying from cow to cow and with the nature of the basal ration in which the feeds were included. The effect is also probably produced more readily when the percentage of fat in the milk is below the normal for the particular class of cow. There is evidence that the effect, if real, is associated with the oils of these foods, and it is perhaps significant that these oils approximate more closely in chemical character to milk fat than the oils in any other feeding stuffs used on the farm. An explanation along these lines receives some support from the fact that in some instances the feeding of butter to a cow has been found to raise the fat percentage in the milk at least over a brief period; but here again the effect cannot be counted upon with certainty, and there are certainly other factors involved beyond the mere supply of fat. These observations do at least raise the possibility that the more nearly the fatty-acid mixture of which the food oil is composed resembles that of milk fat the more readily will it influence the fat secretion.

Of specific effects of food oils upon fat secretion the best substantiated by experiment is that of cod-liver oil in lowering the percentage of fat. This effect may be produced by feeding as little as 2 oz. per day, but with doses of 4-6 oz. the effects are larger and more consistent. Certain vegetable oils, such as rice oil, are suspected of producing a similar effect, but the evidence as yet available is indecisive.

There is evidence that a certain minimum amount of oil is necessary in the cow's ration in order to ensure full secretory activity, but this necessary minimum would appear to be far below any level likely to be met with in farm practice. The effect, if any, is shown in the total yield of milk rather than in the percentage of fat, and is only likely to appear if the amount of digestible oil in the ration is appreciably less than the amount of fat in the milk secreted.

More pronounced than any effects of food oil upon the amount of fat secreted are its effects upon the chemical character of the milk fat. In particular, certain of the "unsaturated" acids of the food oils tend to pass fairly readily into the milk fat, which thereby becomes softer and more "greasy" in physical character. Broadly speaking, it may be said that the higher the proportion of these acids in the food oil, as compared with that in the butter-fat, the greater will be its softening tendency. Milk-fat is formed

partly from the oils and partly from the carbohydrates of the food, and the more abundant therefore the proportion of oils in the food, the greater will be their contribution to the make-up of the butter-fat, and the more pronounced accordingly will be their effect upon its character. This property can be used with advantage on the butter-making farm to secure the desirable degree of firmness in the butter by including softening or hardening foods in the cow's ration according to the effect desired. Maize meal and rice meal are examples of the former, and cottonseed meal, palm kernel cake and coconut cake of the latter type of food.

Influences of Supply of Energy and Protein. Of the various organic food ingredients, that which exercises the most direct and marked effect upon milk secretion is the supply of protein. The nature and extent of this effect varies according to whether the total food supply is adequate or not, and also according to the quality of the milk.

(a) If the total supply of food is inadequate (as measured by content of utilizable energy), but includes an adequate supply of protein, the effect is to cause a gradual fall of milk-yield to a level at which energy equilibrium between intake and outgo is re-established, but there is little or no change in the percentage of fat in the milk.

(b) If, on the other hand, the ration is inadequate as regards both total energy and protein supply the milk yield falls more quickly. In these circumstances, if the fat content of the milk before the reduction of the food supply was about average or higher it will also fall appreciably; but if it was already low (say below 3 per cent.) it will undergo little or no change.

(c) If the total energy supply of the ration is kept adequate, but the protein supply is reduced, the effect on the milk secretion will vary according to whether the fat-content of the milk is high or low. If the fat-content of the milk is high the first effect of lowering the protein supply in the food is to lower the percentage of fat in the milk, with little or no change in the milk yield. After a time (when the negative nitrogen-balance of the cow reaches a certain degree of intensity), a fall in milk yield also takes place. If, on the other hand, the fat content of the milk is already low the preliminary drop in fat percentage does not occur, and the first sign of the change is the fall in the milk yield.

In both instances neither milk yield nor fat percentage can as a rule be restored to the former level by increasing the protein supply unless the period of reduced protein supply has been relatively short.

In this connexion it may be noted that any disturbance of digestion resulting in lowered digestibility of the ration means a reduction in the amount of energy and protein available for the purposes of the animal, and may thus be responsible for some reduction in yield and quality of milk. This is one of the many factors that make it necessary to postulate good management as a prime requisite for success in rationing, especially with high-yielding stock.

As to the level of protein supply that may be considered to be adequate, this question has been so widely and almost continuously discussed in recent years that it will suffice here to recall the general conclusion that a satisfactory standard for the practical conditions of the dairy farm will be maintained by a daily allowance for maintenance of 0.5-0.6 lb. digestible mixed proteins per 1,000 lb. live weight, plus a further allowance for milk production at the rate of 0.4-0.6 lb. digestible mixed proteins per gallon of milk according to fat content. In principle, these allowances should be varied according to the "biological value" of the protein supply, but in practice the necessity for this rarely arises, since most rations contain a sufficient variety of proteins to ensure an adequate level of "biological value."

Influence of Mineral Supply. Although the mineral ingredients of milk probably come more or less directly from the blood, an element of selection is exercised since the quantitative distribution of the mineral elements in the two fluids shows considerable differences. In milk the content of calcium slightly exceeds that of phosphorus, whilst potassium is far more abundant than sodium; in the blood plasma the relative positions are reversed. Blood plasma is far richer in sodium and chlorine (salt) than milk serum. Viewed as a whole, however, the two fluids have one characteristic in common, namely that of equal osmotic pressure, the physico-chemical force which primarily determines the direction and extent of interchanges of soluble ingredients between them.

For a given animal the proportion of total mineral constituents in the milk normally shows little variation throughout the lactation period. With few exceptions, the proportion

of any mineral element in the food seems to have little or no influence upon the proportion of it secreted in the milk. This applies to calcium, phosphorus and iron, but with iodine the small amount of the element normally present in milk can be increased to some extent by adding an iodine compound to the ration.

From experimental investigation of the mineral requirements of the milking cow, and from practical experience, it would appear that the only mineral deficiencies likely to arise at all commonly in farm practice are those with respect to calcium and phosphorus, and the elements of common salt (usually sodium deficiency).

Calcium and phosphorus compounds together form about one-half of the total ash of milk, so that about 1/5 oz. of each element is taken away in every gallon of milk. The food must therefore provide considerably more than these amounts, since it must cover also the needs for maintenance, as well as for the pregnancy if the cow is in calf, and must take account of the fact that there is a large wastage of calcium and phosphorus on their way from the food to the milk.

Experimental studies have shown that where milk yields are liberal the most generous feeding of calcium and phosphorus will commonly not meet the current needs of the cow during the first part of the lactation, but that toward the end of the lactation, and particularly during the dry period, the losses from the body gradually cease and are followed by a storage of the elements which enables the cow to start her next lactation with an ample supply. The whole annual cycle of lactation and gestation must thus be taken into account in considering the supplies of calcium and phosphorus, and particular care must be taken that the supplies are adequate during the closing stages of lactation and the rest period, since only at these stages can the depleted reserves of the body be replenished.

A shortage of phosphorus is less likely to occur in practice than that of calcium, since not only are most rations more liberally supplied with the former, but the animal seems to be better able to build up its phosphorus reserves than those of calcium, and consequently can be satisfied with smaller amounts. There is evidence, moreover, that an excess of phosphorus may cause a fall in milk-yield, and should therefore be avoided. On the other hand it is practically certain that phosphorus plays a part in the synthesis of milk-fat in

the mammary gland, whereby the requirement of phosphorus for production purposes, is raised beyond the amount indicated by the phosphorus left in the milk. Phosphorus deficiency is also a practical problem in many parts of the world where the soils, and therefore the natural herbage, are abnormally poor in phosphorus, and it should obviously be guarded against in all areas where such conditions prevail.

The effects of persistent deficiency of supply of calcium or phosphorus are exercised first upon the bones and there may be no obvious effect upon the milk-yield until the mineral status and strength of the bones have been severely impaired. Sooner or later the stage is reached at which it is no longer possible for the animal to keep up her normal milk flow. The effect on milk secretion may then be shown either by an abnormal shortening of the period of lactation, or by a considerable drop in the peak yield in succeeding lactations. The effect of small deficiencies of calcium and phosphorus is produced only very slowly and may not become evident until after two or three years, the essential effect being to shorten the profitable productive life of the animal. The effects are of course accentuated if the mineral deficiency is accompanied by vitamin-D shortage.

As to the actual requirements of the lactating cow for calcium and phosphorus, it is not possible as yet to give precise guidance. The pioneer work of Forbes and his associates in Ohio suggested that with a lactation yield of 1,000-1,100 gal. the proportion of each element in the dry matter of the ration should not fall appreciably below 0.3 per cent. Other American experiments at the Michigan Station led to the conclusion that the cow should receive for maintenance 8 grm. of calcium and 10 grm. of phosphorus per 1,000 lb. live weight, and in addition 0.9 grm. calcium and 0.75 grm. phosphorus per pound of milk secreted. On this basis a cow weighing 1,200 lb., producing daily 50 lb. of milk at the height of her lactation would require 55 grm. of calcium and 50 grm. of phosphorus per day. In a ration of 30 lb. dry matter, these amounts represent about 0.35 per cent. and are thus in good agreement with Forbes' standards. The necessity for maintaining a good mineral supply throughout the dry period must also be kept in mind and a minimum of 17 grm. daily of each element is suggested for this purpose in the Michigan report.

Danish writers recommend that to rations containing a high allowance of roots a supplement of 50-60 grm. of chalk per

day should be given, or 60-70 grm. if the allowance of roots is reduced. This addition is given primarily to ensure a better " balance " between the amounts of calcium and phosphorus in the ration. For the similar purpose of improving the sodium:potassium ratio an addition of 30-50 grm. of salt daily is also recommended, and this is confirmed by the data obtained in American balance experiments.

Vitamin Supply. The extent to which the supply of vitamins to the lactating animal is essential for the processes of secretion is as yet unknown, but in view of the basic importance of vitamin supply for growth it is not surprising to find that provision is made in the secretory process for ensuring the presence of vitamins in the milk to meet the needs of the young growing animal for which it is intended.

The cow herself requires vitamin A for the efficient discharge of various body functions, but whether this need increases for the specific function of lactation apart from the demand for secretion in the milk has not yet been proved. The first measurable effect of a vitamin-deficient diet is a lowering of the vitamin content of the milk, and should there be any effect on production itself this would almost certainly be accompanied by signs of deficiency in the lactating animal. The need for an adequate supply of the A vitamin in the milk is accentuated by the fact that the new-born calf has little reserve of this vitamin in its body, even though the mother may have been given a liberal supply during pregnancy. The calf derives the benefit of this supply mainly after birth when the reserve stored in the mother's body is drawn upon for her milk. Similar considerations apply to vitamin D.

With regard to vitamin B_1 there is some evidence that a deficiency of this vitamin affects the amount of milk secreted by the rat, but no such evidence is yet available as to the needs of lactating farm animals for this vitamin. Cow's milk as normally produced is rather low in vitamin B_1, and it is apparently difficult to raise the content appreciably by way of the cow's ration. The same appears to apply also to the vitamin B_2, in which, however, the milk is normally richer than in the B_1 vitamin.

Of the other vitamins, the C vitamin is apparently not essential for lactation, but there is some evidence, again based on experience with the rat, that vitamin E may be required, though no positive evidence has yet been obtained of its requirement by other species.

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Wheat, British.. ..	8 5	0 9	7 16	72	2 2	1·16	9·6
Barley, British Feeding	8 0§	0 9	7 11	71	2 2	1·16	6·2
„ Canadian No. 3 Western	7 18	0 9	7 9	71	2 1	1·12	6·2
„ Australian ..	8 5§	0 9	7 16	71	2 2	1·16	6·2
„ Argentine ..	7 12§	0 9	7 3	71	2 0	1·07	6·2
„ Persian ..	7 5*	0 9	6 16	71	1 11	1·03	6·2
Oats, English, white ..	9 7	0 10	8 17	60	2 11	1·56	7·6
„ „ black and grey	9 0	0 10	8 10	60	2 10	1·52	7·6
„ Scotch, white ..	9 10	0 10	9 0	60	3 0	1·61	7·6
„ Canadian— No 2 Western	10 0*	0 10	9 10	60	3 2	1·70	7·6
„ No. 1 feed ..	8 7§	0 10	7 17	60	2 7	1·38	7·6
„ Mixed feed ..	7 17	0 10	7 7	60	2 5	1·29	7·6
„ Argentine ..	9 2	0 10	8 12	60	2 10	1·52	7·6
Maize, American ..	6 13§	0 7	6 6	78	1 7	0·85	7·6
„ Argentine ..	8 3	0 7	7 16	78	2 0	1·07	7·6
„ Danubian, Gal. Fox.	6 13§	0 7	6 6	78	1 7	0·85	7·6
„ Jugoslavian ..	6 13	0 7	6 6	78	1 7	0·85	7·6
„ South African, No. 2 White Flat ..	7 2†	0 7	6 15	78	1 9	0·94	7·6
Beans, English, Winter	8 5§	0 18	7 7	66	2 3	1·21	19·7
Peas, English, blue ..	12 2§	0 16	11 6	69	3 3	1·74	18·1
„ Japanese ..	21 5†	0 16	20 9	69	5 11	3·17	18·1
Dari	7 17†	0 8	7 9	74	2 0	1·07	7·2
Milling Offals—							
Bran, British ..	7 7	0 17	6 10	43	3 0	1·61	9·9
„ Broad.. ..	7 15	0 17	6 18	43	3 3	1·74	10·0
Middlings, fine, imported	7 10	0 14	6 16	69	2 0	1·07	12·1
Weatings‡	7 15	0 15	7 0	56	2 6	1·34	10·7
„ Superfine‡	8 2	0 14	7 8	69	2 2	1·16	12·1
Pollards, imported ..	7 5	0 15	6 10	50	2 7	1·38	11·0
Meal, barley	8 17	0 9	8 8	71	2 4	1·25	6·2
„ „ grade II	8 2	0 9	7 13	71	2 2	1·16	6·2
„ maize	7 10	0 7	7 3	78	1 10	0·98	7·6
„ „ germ ..	7 7	0 12	6 15	84	1 7	0·85	10·3
„ locust bean ..	7 15	0 6	7 9	71	2 1	1·12	3·6
„ bean	9 7	0 18	8 9	66	2 7	1·38	19·7
„ fish (white) ..	15 0	2 6	12 14	59	4 4	2·32	53·0
„ Soya bean (extracted)‡	8 10	1 12	6 18	64	2 2	1·16	38·3
Maize, cooked, flaked	7 17	0 7	7 10	84	1 9	0·94	9·2
„ gluten feed ..	7 12	0 14	6 18	76	1 10	0·98	19·2
Linseed cake—							
English, 12% oil ..	9 17	1 2	8 15	74	2 4	1·25	24·6
„ 9% „ ..	9 5	1 2	8 3	74	2 2	1·16	24·6
„ 8% „ ..	9 0	1 2	7 18	74	2 2	1·16	24·6

PRICES OF FEEDING STUFFS (*continued*)

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Cottonseed cake, English, Egyptian seed, 4½% oil ..	5 7	0 19	4 8	42	2 1	1·12	17·3
Cottonseed cake, Egyptian 4½% oil	5 0	0 19	4 1	42	1 11	1·03	17·3
Cottonseed cake, decorticated, 7–8% oil	7 15†	1 10	6 5	68	1 10	0·98	34·7
Cottonseed meal, decorticated, 7–8% oil	7 15†	1 10	6 5	70	1 9	0·94	36·8
Coconut cake, 5% oil ..	7 10†	0 19	6 11	77	1 8	0·89	16·4
Ground nut cake, 6–7% oil	7 0*	1 0	6 0	57	2 1	1·12	27·3
Ground nut cake, decorticated 6–7% oil	8 2*	1 10	6 12	73	1 10	0·98	41·3
Ground nut cake, imported decorticated, 6–7% oil	7 5	1 10	5 15	73	1 7	0·85	41·3
Palm-kernel cake, 4½–5½% oil	7 5†	0 13	6 12	73	1 10	0·98	16·9
Palm-kernel cake meal, 5½% oil	7 10†	0 13	6 17	73	1 11	1·03	16·9
Feeding treacle ..	5 0	0 9	4 11	51	1 9	0·94	2·7
Brewers' grains, dried ale	6 0	0 12	5 8	48	2 3	1·21	12·5
Brewers' grains, dried porter	5 12	0 12	5 0	48	2 1	1·12	12·5

* At Bristol. § At Hull † At Liverpool.
‡ In these instances manurial value, starch equivalent and protein equivalent are provisional.

NOTE · The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the beginning of June, 1938, and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative values of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, if linseed cake is offered locally at £11 per ton, then since its manurial value is £1 2*s* per ton as shown above, the cost of food value per ton is £9 18*s*. Dividing this figure by 74, the starch equivalent of linseed cake as given in the table, the cost per unit of starch equivalent is 2*s* 8*d*. Dividing this again by 22·4, the number of pounds of starch equivalent in one unit, the cost per lb. of starch equivalent is 1·43*d*. Similar calculations will show the relative cost per lb of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own markets. The figures given in the table under the heading manurial value per ton are calculated on the basis of the following unit prices: N., 7*s*. 9*d*.; P_2O_5, 2*s*. 7*d*.; K_2O, 3*s*. 8*d*.

PRICES OF ARTIFICIAL MANURES

Description		Average prices per ton (2,240 lb.) during week ended June 15				
		Bristol	Hull	L'pool	London	Costs per Unit¶
		£ s.	£ s	£ s	£ s.	s. d.
Nitrate of Soda (N 15½%) ..		8 0c	8 0c	8 0c	8 0c	10 4
,, ,, Granulated (N 16%)		8 0c	8 0c	8 0c	8 0c	10 0
Nitrate of Lime (N 13%) ..		7 7e	7 7e	7 7e	7 7e	11 4
Nitro-Chalk (N 15½%).. ..	*	7 10c	7 10c	7 10c	7 10c	9 9
Sulphate of Ammonia — Neutral (N 20·6%)		7 14c	7 14c	7 14c	7 14c	7 6
Calcium Cyanamide (N 20·6%)		7 16d	7 16d	7 16d	7 16d	7 7
Kainite (Pot 14%)		2 18	2 15	2 15	2 15	3 11
Potash Salts (Pot 30%) ..		5 4	5 1	5 0	5 1	3 5
,, ,, (Pot. 20%) ..		3 15	3 12	3 12	3 12	3 7
Muriate of Potash (Pot 50%)..		8 10	8 8	8 5	8 8	3 4
Sulphate of ,, (Pot. 48%)..		10 2	10 0	9 17	10 0	4 2
Basic Slag (P A. 15¾%) ..		2 12b	2 5b	—	2 10b	3 2
,, ,, (P A 14%)	§	2 8b	2 0b	2 0b	2 6b	3 3
Grd Rock Phosphate (P A 26–27½%)		3 7a	3 2a	2 18a	2 10a	1 10
Superphosphate (S P A 16%)..		3 4	—	3 5f	3 2g	3 11
,, (S P A 13¾%)		3 1	2 17	3 2f	2 19g	4 3
Bone Meal (N 3¾%, P A 20½%)		—	7 5	7 0h	6 17	—
Steamed Bone Flour (N. ¾%, P A. 27½–29¾%)		5 5i	5 5	4 15h	4 10	—

Abbreviations N. = Nitrogen , P A = Phosphoric Acid ;
S P A = Soluble Phosphoric Acid , Pot = Potash

* Prices are for not less than 6-ton lots, at purchaser's nearest railway station, unless otherwise stated Unit values are calculated on carriage-paid prices.

§ Prices are for not less than 2-ton lots, nett cash for prompt delivery f o r. in town named, unless otherwise stated Unit values are calculated on f o r prices

a Prices for 4-ton lots f o r Fineness 85% through standard sieve

b Prices for 6-ton lots Prices at Bristol are f o r. Bridgwater , at Hull and Liverpool f o r. neighbouring works and at London f o r at depots in London district. Fineness 80% through standard sieve

c For lots of 4 tons and under 6 tons the price is 1*s*. per ton extra, for lots of 2 tons and under 4 tons, 5*s* per ton extra and for lots of 1 ton and under 2 tons, 10*s* extra

d Delivered in 5-ton lots at purchaser's nearest railway station For lots of 2 tons and under 5 tons the price is 5*s*. per ton extra, for lots of 1 ton and under 2 tons, 10*s* per ton extra and for lots of 4 cwt and under 1 ton, 20*s* extra.

e For lots of 4 tons and under 6 tons the price is 1*s* per ton extra, for lots of 2 tons and under 4 tons, 5*s* per ton extra, for lots of 1 ton and under 2 tons 7*s* 6*d* per ton extra and for lots of under 1 ton, 20*s* extra

f Prices shown are f o r Widnes

g Prices shown are ex works London ; f.o.r southern rails, 1*s*. 3*d* extra.

h Prices shown are f o r Appley Bridge.

i Price shown is f o r Newport, Mon

¶ *These are calculated by regarding a ton as comprising* 100 " *units* " (*equal parts of* 22·4 *lb*) *so that a fertilizer, for example, with* 16 *per cent. nitrogen, contains* 16 *such* " *units* " *in a ton Then, if the price per ton of such a fertilizer be divided by the percentage figure, the deduced cost is that of a* " *unit* " *of that agent. Those in the table above are based on London prices* (*For further explanation, see Advisory Leaflet, No* 146, " *The Valuation of Artificial Manures,*" *obtainable from the Ministry, free of charge*)

MARKETING NOTES

Milk Marketing Scheme. The wholesale price for liquid milk (other than Tuberculin Tested milk) in May, 1938, was 1*s*. 1⅛*d*. per gal., 1*d*. more than in May, 1937; the wholesale price for Tuberculin Tested milk in May, 1938, was 1*s*. 3⅛*d*. per gal. The ⅛*d*. represents in each instance the purchasers' contribution towards a publicity fund; a similar contribution is made by producers by an allocation from the Board's funds.

Pool Prices for May, 1938, are given below, with comparative figures for April, 1938, and May, 1937.

	Pool Prices		
	May 1938 *d.*	*April* 1938 *d.*	*May* 1937 *d.*
Northern	10	12½	9¼
North-Western	10	12½	9¼
Eastern .	10¼	12¾	9½
East Midland .	10	12½	9¼
West Midland .	9¾	12¼	9
North Wales .	10	12¼	9
South Wales .	10	12½	9¼
Southern .	10½	12¾	9¾
Mid-Western .	9¾	12	9
Far-Western .	9¾	12	9
South-Eastern	10¾	13	10
Unweighted Average	10·07	12·45	9·30

These prices are exclusive of any premium for special services and level deliveries, and also of the quality bonuses for Accredited and Tuberculin Tested milks. The estimated gallonage on which quality premiums have been earned was 41,770,203.

The inter-regional compensation levy was fixed at 1¼*d*. per gal. the same as in May, 1937. Sales on wholesale contracts were as follows:—

	May, 1938 (*estimated*) *Gal*	*May*, 1937 (*estimated*) *Gal*
Liquid	53,793,211	49,730,968
Manufacturing	36,288,889	39,352,145
	90,082,100	89,083,113
Percentage liquid sales	59·72	55·83
Percentage manufacturing sales ..	40·28	44·17

The average realization price of manufacturing milk during May was 6.61*d*. per gal. compared with 5.41*d*. per gal. for

May, 1937. The quantity of milk manufactured into cheese on farms was 3,350,095 gal. compared with 1,639,449 gal. in the previous month and 2,946,687 gal. in May, 1937.

Proposed Variation in the Regional Wholesale Liquid Milk Price. The Milk Marketing Board applied to the Central Milk Distributive Committee for a variation in the regional wholesale price of liquid milk, by an increase of 4*d.* per gal. in the months of June and July, 1938. The increased cost of production, due to the continued use of artificial feeding-stuffs made necessary by the effect of the drought on pastures, was given as the reason for the Board's application. Agreement was not reached, and under the terms of the Contract the matter was referred to Sir Stephen Demetriadi, the "consulted person" agreed upon between the parties. The case was heard on June 10, and the "consulted person" has certified that the wholesale price of milk for the month of July shall be varied from 1*s.* 1*d.* per gal. to 1*s.* 5*d.* per gal. in respect of Contracts G.C. 38/1 and G.C. 38/2, and from 1*s.* 3*d.* per gal. to 1*s.* 7*d.* per gal. in respect of the Tuberculin Tested milk Contract T.T.C. 38/4.

Regional Elections. Elections of Regional members took place in four regions on June 4. Mr. P. R. M. Jaggard, Mr. Ben Hinds, and Mr. J. Joyce, retiring members, were returned unopposed for the East Midland, South Wales and Mid-Western Regions respectively, and Lt.-Col. J. F. Duncan was re-elected for the Southern Region.

Annual General Meeting. The Fifth Annual General Meeting of registered producers was held on June 8, 1938. The retiring special member of the Board, Mr. Trehane, was returned unopposed.

The Board presented to the meeting a Report on the operation of the Scheme for the year ended March 31, 1938, together with a Statement of Accounts. The Report shows that the number of producers selling milk by wholesale increased from 84,610 on March 31, 1937, to 89,105 on March 31, 1938, an increase of 4,495, or 5.3 per cent., and the number of wholesale contracts registered with the Board increased from 91,588 to 96,872, i.e., by 5,284, or 5.8 per cent. This increase is due partly to the withdrawal of the exemption from the Scheme since October 1, 1937, of producers of Tuberculin Tested milk and producers with not more than four cows selling by wholesale. The number of licensed producer-retailers declined from 64,846 to 63,445, i.e., by 1,401 or 2.2 per cent.

The total quantity of milk sold under the Scheme, compared with the two previous years was as follows:—

	'000 *Gallons*		
	1937–38	1936–37	1935–36
Sold by wholesale under Contract	867,306	883,612	868,386
*Producer-retailers' sales and milk for schools sold direct by producers	122,770	109,996	107,745
Farmhouse cheesemakers' sales .	21,174	18,274	15,182
Total quantity of milk passing through the Board	1,011,250	1,011,882	991,313

* Includes sales of T T. milk since October 1, 1937, of 6,312,140 gallons.

The respective quantities of milk sold in the liquid and manufacturing markets were:—

	'000 *Gallons*		
	1937–38	1936–37	1935–36
Liquid . .	720,677	669,372	656,775
Manufacturing	290,573	342,510	334,538
	1,011,250	1,011,882	991,313

It will be noted that while there has been a slight decrease in the quantity of milk sold under the Scheme, sales to the liquid market have increased by 51 million gal., or 7.6 per cent.

The amount realized from sales of milk under wholesale contracts was £47,321,049, compared with £44,182,471 in the previous year, an increase of £3,138,578.

There were 1,137 farmhouse cheesemakers' contracts in operation during the year under review, compared with 1,070 a year previously, an increase of 67. The average grant payable to farmhouse cheesemakers was 3.83*d.* per gal., compared with 4.58*d.* in the previous year. The rise in cheese prices during the past year has rendered inoperative any Government contribution under the Milk Acts.

The Board continue to extend their manufacturing facilities by the acquisition of new premises and the re-equipment of certain existing factories. At the end of the financial year the Board had sixteen factories in operation compared with ten a year previously.

Wheat Act, 1932: *Sales of Home-Grown Wheat—Cereal Year* 1937-38. Certificates lodged with the Wheat Commission

by registered growers during the period August 1, 1937, to June 3, 1938, cover sales of 21,972,904 cwt. of millable wheat as compared with 20,589,592 cwt. in the corresponding period (to June 4) last year.

Amending Legislation. In reply to questions in the House of Commons on June 14 the Minister of Pensions (speaking on behalf of the Minister of Agriculture) stated that, in view of the pressure on Parliamentary time, it would not be possible to secure the passage into law before the Summer Recess of legislation amending the Wheat Act. Legislation proposing amendments to deal with a number of outstanding problems, including provision for periodical reviews of the standard wheat price, would, however, be introduced as soon as possible after the Recess.

Milk Acts, 1934 to 1937: *Milk-in-Schools Scheme.* The following are comparative figures of the consumption of milk under the Scheme in England and Wales in the six months October to March inclusive in each of the past four years:—

Year	*Consumption in Six Months October to March (Gal.)*
1934–35	13,105,000
1935–36	12,048,000
1936–37	12,071,000
1937–38	13,831,000

Sugar Industry (Reorganization) Act, 1936: 1938 *Beet Contracts.* Growers have contracted with the British Sugar Corporation to grow approximately 340,000 acres of sugar-beet in 1938 compared with 332,000 acres in 1937.

Livestock Industry Act, 1937: *Livestock Markets.* The Livestock Commission are entrusted with certain functions relating to markets under Part IV of the Livestock Industry Act, and they have accordingly prepared a memorandum for the guidance of market owners who contemplate the construction of new markets or the extension or reorganization of existing markets. The memorandum, which has been considered in detail by the Livestock Advisory Committee, sets out the features which the Commission would normally expect to find incorporated in plans of markets which they are required to approve under Section 14 of the Act. Copies of the memorandum have been supplied to market owners and other persons likely to be

interested and may be obtained free of charge on application to the Secretary, Livestock Commission, 1, Sanctuary Buildings, Great Smith Street, S.W.1.

Slaughterhouse Schemes. Part V of the Livestock Industry Act makes provision for the conduct of three experiments in central slaughtering on the factory principle. In reply to a question by Mr. R. T. D. Acland, the Member for Barnstaple, on June 14, it was stated on behalf of the Minister that a number of local authorities and other bodies, after consultation with the Livestock Commission, were preparing proposals which might form the basis of slaughterhouse schemes under Part V of the Act, and the Commission had already received provisional proposals from three local authorities. No detailed arrangements, however, had yet been completed or submitted for consideration. The reply continued that the Commission were in consultation with the Livestock Advisory Committee on the matters for which provision may be made by slaughterhouse schemes, and it was hoped to publish in the near future suggestions for the guidance of local authorities and other bodies with a view to facilitating the preparation of proposals and expediting the submission of detailed arrangements for consideration by the Commission.

Potato Marketing Scheme: *Amendments.* Twenty-nine objections and one representation with respect to the proposed amendments of the Scheme were received within the prescribed time ending on May 7. In accordance with the requirements of the Agricultural Marketing Act, 1931, the Minister of Agriculture and Fisheries and the Secretary of State for Scotland have directed a public inquiry to be held into the objections. The inquiry will be conducted by Mr. C. T. Le Quesne, K.C., and will be opened in Temporary Court "B," Judges' Quadrangle, Royal Courts of Justice, Strand, London, W.C.2, at 10.30 a.m., on Monday, July 11, 1938. The proceedings will subsequently be adjourned to Edinburgh and will commence there at the Scottish Land Court, 1, Grosvenor Crescent, Edinburgh, at 11.0 a.m., on Monday, July 18, 1938.

Hops Marketing Scheme. The retiring district members of the Hops Marketing Board have been re-elected for a further year and, at the meeting of the Board held on June 16, Mr. W. J. Woolrich and Mr. G. H. Edwards were re-elected Chairman and Vice-Chairman respectively.

The estimated market demand for hops for 1938 has been

fixed at 232,000 cwt., as compared with 222,500 cwt. for 1937, and the total of annual quotas at 102 per cent. of basic quotas, as against 98 per cent. for 1937. Interchange of annual quotas for the 1938 crop will be permitted until October 10, 1938. This date has also been fixed as the latest date for tendering to the Board hops of the 1938 season.

Amendments of the Scheme. In May, 1938, the Board published to producers certain amendments of the Scheme that they proposed to submit to the Minister in accordance with the provisions of the Agricultural Marketing Acts, 1931 to 1933. A poll on the question whether these amendments should be submitted was subsequently demanded by registered producers growing hops on the requisite number of acres provided for in the Scheme, and the result of this poll was announced on June 18. The voting was as follows:—

In favour of submission
831 producers representing 14,650 acres.
Against submission
7 producers representing 87 acres.

The Agricultural Marketing Acts provide that if, on a poll of registered producers on the question of the submission of amendments of an agricultural marketing scheme, those voting in favour of the submission of the amendments (*a*) number not less than two-thirds of the total number of registered producers voting, and (*b*) are capable of producing not less than two-thirds of the quantity of the regulated product which all the registered producers voting are capable of producing, then the amendments may be submitted. The result of the poll given above is conclusive in favour of the submission of the amendments.

National Mark Schemes for Cheese. In the light of experience gained in the operation of the National Mark Cream Cheese Scheme, the National Mark Cheese Trade Committee recently recommended that the Extra Selected (Double Cream) Grade should be re-defined to require a minimum standard of 60 per cent. butter fat in the cheese instead of the present standard of 70 per cent., and that the Selected Grade should be deleted from the Regulations.

The Minister has given effect to these recommendations by the promulgation of the Agricultural Produce (Grading and Marking) (Cream Cheese) Regulations, 1938, which came into operation on May 27, 1938.

The quantities of cheese packed under the National Mark during the quarter ended March 31, 1938, with comparative figures for 1937 are as follows:—

Type of Cheese	Quarter ended March 31, 1937	Quarter ended March 31, 1938
	(cwt)	(cwt)
Cheshire:		
(a) Farm made	3,888	6,819
(b) Creamery made	2,503	2,455
Stilton:		
(a) Blue	240	152
(b) White	594	552
Caerphilly	4,473	4,122
Cheddar	1,083	279
Lancashire	3,315	2,664
Wensleydale	190	433
Cream	14½	10
Leicester	114	145
Derby*	20	69

* Scheme came into operation on February 8, 1937.

The increase as compared with the corresponding quarter last year with regard to Wensleydale is due to the packing of small cheese of under 2 lb. under the National Mark, which has been permitted since October, 1937.

Marketing Demonstrations. Particulars of exhibits and demonstrations to be staged by the Ministry during July are as follows:—

Show	*Demonstration*
Royal, Cardiff July 5–9	Egg Grading and Livestock Demonstration. Egg, Honey, Dairy, Fruit, and Vegetable Exhibits.
Kent, Folkestone July 13–15.	Apple Grading and Egg Grading Demonstrations. Egg, Fruit and Vegetable Exhibits.
Great Yorkshire, Doncaster July 13–15.	Egg Grading and Livestock Demonstrations. Egg, Honey, Poultry, Dairy, and Vegetable Exhibits.
Royal Lancs, Liverpool July 28–Aug. 1.	Egg Grading and Tomato Grading and Livestock Demonstrations. Egg, Poultry, Dairy, and Vegetable Exhibits.

A bookstall for the sale of the Ministry's publications will be staged at the Warwickshire Agricultural Show at Nuneaton on July 22 and 23.

MISCELLANEOUS NOTES

The Agricultural Index Number, May, 1938

The general index number of prices of agricultural produce for May at 125 (base May, 1911-13=100) is 7 points lower than a month ago and 8 points below that recorded for the corresponding month last year. If allowance be made for payments under the Wheat Act, 1932, and the Livestock Industry Act, 1937, the revised index for the month becomes 130. Compared with April, average prices of wheat, oats, eggs, cheese, potatoes and hay advanced, but those of barley, fat cattle, sheep and pigs, butter, milk and wool declined.

Monthly index numbers of prices of Agricultural Produce. (*Corresponding months of* 1911–13 = 100)

Month	1933	1934	1935	1936	1937	1938
January	107	114	117	119	130	134
February	106	112	115	118	129	130
March	102	108	112	116	130	126
April	105	111	119	123	140	132
May	102	112	111	115	133	125
June	100	110	111	116	131	—
July	101	114	114	117	131	—
August	105	119	113	119	133	—
September	107	119	120	127	137	—
October	107	114	113	125	131	—
November	109	114	113	125	133	—
December	110	113	114	126	132	—

Revised monthly index numbers of prices of Agricultural Produce, allowing for payments under the Wheat Act (*a*) *and for the Cattle subsidy* (*b*)

Month	1933	1934	1935	1936	1937	1938
January	111	119	124	125	133	138
February	110	117	122	123	133	135
March	106	112	118	122	134	131
April	109	116	126	128	143	137
May	105	116	117	120	136	130
June	104	114	117	121	134	—
July	104	117	120	121	134	—
August	108	122	120	124	136	—
September	111	125	128	133	142	—
October	112	121	119	129	134	—
November	113	120	119	129	137	—
December	114	120	120	130	136	—

(*a*) Commenced August, 1932. (*b*) Commenced September, 1934.

In the following table the monthly index numbers of prices of individual commodities are shown for the months of February to May, 1938, May, 1937, and May, 1936; base, the corresponding months of 1911-13=100.

Commodity	1938				1937	1936
	May	Apr.	Mar.	Feb.	May	May
Wheat	100	100	104	109	124	84
Barley	137	146	153	156	133	105
Oats	111	113	119	119	119	82
Fat cattle	111	115	117	121	112	94
„ sheep	110	119	118	122	160	130
Bacon pigs	124	130	129	132	118	113
Pork „	126	132	133	135	116	108
Eggs	133	129	116	122	112	109
Poultry	127	118	136	130	122	121
Milk	175	215	171	181	162	162
Butter	121	111	105	105	106	96
Cheese	128	119	119	121	112	103
Potatoes	170	120	138	140	196	174
Hay	79	76	77	76	100	82
Wool	95	102	104	115	141	96
Dairy cows	116	117	120	123	112	101
Store cattle	112	119	123	123	115	96
„ sheep	90	105	99	102	133	107
„ pigs	140	145	143	151	125	118

Revised index numbers due to payments under the Wheat Act and to the Cattle subsidy.

Wheat	125	131	134	134	125	115
Fat cattle	125	129	132	136	126	107
General Index	130	137	131	135	136	120

Grain. Wheat, at an average of 7*s.* 11*d.* per cwt., showed a rise of 4*d.* but, with a similar movement in the base years, the index remains unchanged. If the deficiency payment under the Wheat Act, 1932, is taken into account the index is 125. Barley at 10*s.* 6*d.* per cwt. averaged 8*d.* less and the index falls by 9 points. Quotations for oats advanced by 3*d.* to 8*s.* 3*d.* per cwt., but, owing to a greater increase in the base price, the index is 2 points lower. In May, 1937, wheat averaged 9*s.* 10*d.*, barley 10*s.* 2*d.* and oats 8*s.* 10*d.* per cwt.

Live Stock. All classes of live stock made less money during the month under review. Second quality fat cattle averaged 11*d.* less, at 41*s.* 2*d.* per live cwt., and the index declines by

4 points. If the subsidy under the Livestock Industry Act, 1937, is added, the index becomes 125. Average prices of second quality fat sheep at 8¼d. per lb., were 1¼d. per lb. lower and the index is reduced by 9 points. Quotations for bacon pigs fell by 8d. to 12s. 4d. per score (20 lb.) and those for porkers by 9d. to 13s. 3d. per score, the relative indices moving downwards by 6 points.

Dairy cows were slightly cheaper in May and the index declines by 1 point; store cattle also were quoted lower and a fall of 7 points is shown in the index. Quotations for store sheep and pigs declined, the respective indices being reduced by 15 and 5 points.

Dairy and Poultry Produce. Owing to a fall of 3d. per gallon in the regional contract price of liquid milk, the index shows a decrease of 40 points. Butter averaged ½d. less, at 1s. 2½d. per lb., but, with a greater fall recorded in the corresponding months of 1911-13, the index appreciates by 10 points. Eggs, at 10s. 10d. per 120, realized increased prices and an advance of 4 points is shown in the index. At £4 12s. 6d. per cwt., cheese was quoted higher, the index moving upwards by 9 points. The combined index for poultry at 127 compares with 118 a month ago.

Other Commodities. Potatoes averaged £7 12s. 6d. per ton, an increase of £2 3s., and the index rises by 50 points. Both clover and meadow hay realized somewhat more money during May, the combined index being 3 points higher. Prices of wool fell by ⅞d. to 1s. 0¼d. per lb. and the index declines by 7 points.

Colorado Beetle in Switzerland

In consequence of the spread of the Colorado Beetle into Switzerland, the Minister of Agriculture and Fisheries has made an Order—The Importation of Plants (Amendment) Order of 1938*—which imposes restrictions on the importation into this country from Switzerland of certain kinds of horticultural produce. Similar restrictions are already in force regarding horticultural produce from France, Belgium, Germany and Luxemburg. The new Order came into force on June 13, 1938.

* S.R. & O. 1938 No. 517. Obtainable from H.M. Stationery Office. Price 1d.

The following is a summary of its provisions:—

(*a*) A Colorado Beetle Certificate in one of two forms is required to accompany living plants, potatoes, raw vegetables and cider apples imported from Switzerland.

(*b*) The alternative forms of Colorado Beetle Certificate are (i) that the produce was grown outside a radius of 50 kilometres from an outbreak, (ii) that the importation is permitted by a general licence granted by the Minister, and that the conditions laid down in the licence have been observed. Alternative (ii) is not applicable to potatoes.

Infestation of Stored Grain and Grain Products by Insects

The Department of Scientific and Industrial Research announce that a new investigation is to be carried out under the auspices of the Department on the "Infestation of Grain by Insects," by the Stored Products Laboratory of the Imperial College of Science and Technology.

Destruction of stored grain and grain products by insects causes great loss to many sections of industry, probably amounting annually to not less than £5,000,000. The first step to be taken in dealing with this problem is a scientific survey, which is to be made at once during the period of seasonal activity of the insects. This survey has been organized on the initiative of the various sections of industry concerned, and the major part of its cost will be met by their contributions. The co-operation of all sections of industry affected is essential to the success of any organized attack on these insect pests. The neglect of one section to play its part will jeopardize the success of the efforts of all the rest. A representative Conference of interested bodies, which met at the offices of the Department of Scientific and Industrial Research on May 26, 1938, viewed with satisfaction the extent of the support so far accorded, and commended the support of the Investigation to the earnest consideration of all sections of trade and industry which suffer from the destruction of stored grain and grain products by insects. Any organization or undertaking wishing to co-operate in this work should communicate with the Secretary of the Department of Scientific and Industrial Research, 16, Old Queen Street, Westminster, S.W.1.

Inspection and Certification of Strawberry Plants, 1938

The Ministry is prepared to accept applications for the inspection of stocks of Strawberry Plants from which it is intended to take runners for sale during the 1938 season, with a view to their certification if found to be true to variety and reasonably healthy.

Forms of application and copies of a memorandum in which are given full particulars of the scheme and of the fees payable can be obtained from the Ministry's Offices at 10, Whitehall Place, London, S.W.1. Growers wishing to participate in the scheme should bear in mind that applications for inspection must reach the Ministry *not later than July* 16, 1938. *Applications received after that date cannot be accepted.*

Potato Purity Certification

Potato growers generally realize that disappointment and loss attend the growing of crops from seed which is not true to variety. The demand for seed potatoes from true stocks is therefore increasing, and to help to meet this demand the Ministry arranges each year for the inspection of growing crops with a view to their certification if found to be true to type and reasonably free from rogues. Arrangements are now being made for the inspection of this year's crops, and all growers in England and Wales who intend to sell potatoes for planting next season are invited to apply for the inspection of their crops.

Definite identification of potato varieties can be undertaken only when the crops are in full growth, and it is essential therefore that applications should be submitted early so that inspection can be made before the foliage has died down. Applications in respect of early varieties should have been made not later than June 21, and those in regard to late kinds should be made before July 21.

The fee payable on application for inspection is at the rate of 2*s*. 6*d*. per acre or part of an acre. Forms of application can be obtained from the Ministry's Offices at 10, Whitehall Place, London, S.W.1.

Potato Demonstration Plots

The National Institute of Agricultural Botany, in co-operation with the Potato Marketing Board and the County Agricultural Organizers, has arranged a series of demonstration plots of newer varieties of second early and maincrop potatoes.

The second early varieties are Arran Signet, Dunbar Rover and Eclipse, and the farms on which the plots have been arranged are:—

KENT: A. G. Batchelor, Gattons Farm, Cliffe, Nr. Rochester.
ESSEX: East Anglian Institute of Agriculture, Sturgeon's Farm, Writtle, Nr. Chelmsford.
BEDS: F. Inskip, Shefford Hardwicke, Shefford.
LINCS: The Lincolnshire County Council Agricultural Institute, Kirton.
LANCS*: J. M. Andrew, County Council Farm, Hutton.
YORKS*: G. Dickson, Bridgefield, Brayton, Selby.
DURHAM*: J. Wilson, Houghall Farm, Shincliffe.

The maincrop varieties are Arran Peak, Dunbar Standard, Gladstone, Majestic and Redskin,* and the farms on which the plots have been arranged include those mentioned above with the exception of Gattons Farm, Cliffe. Maincrop varieties only are also arranged at the following farms:—

KENT: W. Alexander, Home Farm, Eynsford.
ISLE OF ELY: A. D. Burton, The Elms, Benwick.
LEICESTERSHIRE: W. H. Brickwood, Manor Farm, Cotes, Loughborough.
SHROPSHIRE: W. B. Thompson, Harper Adams Agricultural College, Newport.
WORCESTERSHIRE: W. H. Pratt, Pound Farm, Astley.
CUMBERLAND*: Grant Hutchinson, Nord Vue, Armathwaite.

Field days are to be arranged when the crops may be examined. Further particulars can be obtained from the local County Agricultural Organizer, or from the Potato Marketing Board, Africa House, Kingsway, W.C.2, or from the National Institute of Agricultural Botany, Huntingdon Road, Cambridge.

The Ministry's Advisory Publications

Since the date of the list published in the April, 1938, issue of this JOURNAL (p. 87), the undermentioned Advisory Publications have been issued by the Ministry.

Bulletins:

No. 37.—Ensilage. (4th Edition.) 1*s.* (1*s.* 2*d.*, post free).
Largely rewritten in the light of a number of fundamental investigations into modern developments in silo construction and recent work dealing with the conservation of young grass. (See p. 294 of last month's issue for more complete information.)

No. 94.—Potatoes. 1*s.* (1*s.* 2*d.*, post free).
Written primarily for the commercial grower, this Bulletin deals with all aspects of potato-growing.

No. 108.—Weeds of Arable Land. (2nd Edition.) Quarter-bound. 4*s.* (4*s.* 6*d.*, post free).

* The maincrop variety Redskin is included only at the centres marked with an asterisk.

Substantially revised as a result of the many changes in the methods of control and eradication of weeds in recent years, e.g., the introduction of spraying of corn crops with sulphuric acid. (See advt. p. vi for more complete information.)

No. 110.—Commercial Flower Production. Part III. Foliage and Foliage Plants. 1s. (1s 2d.).

This Bulletin forms Part III of the attractive series of Bulletins devoted to the cultivation of flowers for market.

No. 111.—Commercial Apple Production 1s. 6d. (1s. 8d., post free).

Deals comprehensively with the cultivation of apples by approved modern orchard methods

Copies of the above are obtainable at the prices mentioned from the Sale Offices of H.M. Stationery Office or through any bookseller.

Advisory Leaflets:

No. 114.—The Control of Fruit Pests and Diseases in Gardens and Small Orchards. (Revised.)
No 167.—Hand and Machine Milking. (Revised.)
No. 190.—Bracken. (Revised.)
No. 286.—The Chrysanthemum Midge. (Revised.)

Copies of any of the above-mentioned leaflets may be purchased from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2, or at the Sale Offices of that Department at Edinburgh, Manchester, Cardiff, and Belfast, price 1*d*. each net (1½*d*. post free), or 9*d*. net per doz. (10*d*. post free).

Single copies of not more than 20 leaflets may, however, be obtained, free of charge, on application to the Ministry. Further copies beyond this limit must be purchased from H.M. Stationery Office, as above.

A list of the Ministry's publications, including bulletins and leaflets, on agriculture and horticulture may be obtained free and post free on application to the Ministry.

Agricultural Machinery Testing Committee

The Ministry undertakes to test agricultural implements and machinery with the object of furnishing accurate information regarding the utility, efficiency and reliability of each machine or implement tested. A leaflet (No. A396/T.G.) giving an outline of the scheme can be obtained, post free, from the Ministry. Certificates and reports embodying the results of each test are published in pamphlet form by His Majesty's Stationery Office, Adastral House, Kingsway, London. W.C.2.

A pamphlet published recently (Certificates and Reports No. 68, price 2*d*.) relates to *The Headen Keil Anti-Dilution*

Cylinder-Head Gasket, which has been tested to determine the effect of the gasket on the maximum power developed by a tractor engine and on fuel consumption and oil dilution. The tests were carried out by the Institute for Research in Agricultural Engineering, University of Oxford.

Grassland Improvement

As in former years, the Ministry undertook the co-ordination of the Agricultural Education and Research Exhibits at the Bath and West Show at Plymouth on May 25-28, and at the Royal Show at Cardiff on July 5-9, and special prominence was given this year to exhibits illustrating methods of improving grass land and restoring the fertility of the soil. A turf section, which was a feature of the exhibit at each Show, was designed to show the effect, after varying periods of years, of treatment by way of cultivation and the application at different times of quantities of various kinds of manures.

The Ministry also co-operated with the County and College Staffs concerned in staging grassland exhibits at the Three Counties Show at Gloucester on June 7-9, and at the Shropshire and West Midland Show at Shrewsbury on May 25-26. The grassland exhibit at the latter Show was also staged at the Staffordshire Show at Stone on June 16 and will be repeated at the Warwickshire Show at Nuneaton on July 22-23.

APPOINTMENTS

COUNTY AGRICULTURAL EDUCATION STAFFS: ENGLAND

Devon: Mr. H. T. Shaw, B.Sc, has been appointed District Lecturer in Agriculture.

Dorset: Mr. W. E Richards, B.Sc. (Agric.), N.D A, has been appointed Lecturer in Agriculture, and Miss M. A. Blore, B Sc (Dairying), N.D.D, has been appointed Second Instructress in Dairying.

Herts: Mr. F. W. Dunnett, N.D.A., has been appointed temporary Assistant Lecturer in Agriculture.

Lancashire: Mr. K. J. Allright, B.Sc, N D.A., has been appointed District Agricultural Organiser and Warden *vice* Mr. O. J. Pattison, M.Sc., N D.A.

Northumberland: Miss J. H Mitchell, N.D.D, has been appointed Instructress in Dairying and Poultry Keeping *vice* Miss E Cuthbertson, N.D.D.

WALES.

Monmouthshire: Mr. R. F. Hall, N.D P, Assistant Instructor in Poultry Keeping, has been appointed County Poultry Adviser *vice* Mr. C. H. King, deceased.

WIRELESS TALKS, JULY, 1938

Station and Date	*Time: p m.*	*Speaker*	*Subject*
National:			
July 6	6 25	Various	The Royal Show
North:			
July 13	8 00	—	Eye-witness account of the Great Yorkshire Show
Midland:			
July 13	8 35	C Norbury, W Dallaway and Prof. Sargant Florence	"Gluts in the Fruit Market"
West:			
July 1	8 15	R H. Smith, L G Troup, and A W Ling	"Training for the Land"
,, 14	6 40	—	For Western Farmers
Scottish:			
July 5	6 30	—	Crofting Talk—Potatoes
,, 7	7 00	James Picken	Empire Marketing Problems
,, 14	6 55	A Manson	"The Farmers' Union"
,, 21	7 00	—	For Scottish Farmers
Northern Ireland:			
July 18	10 00	Peter Fitzpatrick	Farmer's Work and Worry

FARM WORKERS' MINIMUM RATES OF WAGES

Agricultural Wages Board.—A meeting was held at Kings Buildings, Smith Square, London, S.W.1, on May 30, 1938. The Board considered notifications from Agricultural Wages Committees of decisions fixing minimum and overtime rates of wages, and proceeded to make the following Orders:—

Bedfordshire and Huntingdonshire. An Order cancelling the existing minimum and overtime rates of wages and fixing fresh rates in substitution therefor, came into force on June 5, 1938, and continues in operation until October 29, 1938 The minimum rates for male workers of 21 years of age and over are 34s. (as formerly) per week of 41 hours in the weeks in which Whit Monday and August Bank Holiday fall, and 50 hours in any other week, with overtime unchanged at 10½d. per hour on weekdays and 1s. 0½d. per hour on Sundays. The minimum rates for female workers of 18 years of age and over are unchanged at 6½d. per hour, with overtime at 8d. per hour on weekdays and 9½d. per hour on Sundays.

Dorsetshire. An Order fixing minimum and overtime rates of wages to come into operation on July 1, 1938 (i.e., the day following that on which the existing rates are due to expire), and to continue in force until May 27, 1939. The minimum rates are as follows:—(*a*) In the case of male workers of 21 years of age and over 34s. (instead of 33s.) per week of 42 hours in the weeks in which Good Friday, Easter Monday, Whit Monday and August Bank Holiday fall, 51 hours in any other

week in summer, 39½ hours in the week in which Boxing Day falls, and 48 hours in any other week in winter. (*b*) In the case of female workers of 21 years of age and over (other than part-time and casual workers), 25s. (instead of 24s.) per week of 39½ hours in the weeks in which Good Friday, Easter Monday, Whit Monday, August Bank Holiday and Boxing Day fall, and 48 hours in any other week. (*c*) In the case of part-time or casual female workers of 18 years of age and over, 6d. per hour (instead of 5d.). The overtime rates are 9d. per hour (as at present) for male workers of 21 years of age and over except for overtime employment in the Hay and Corn Harvests, when the rate is 10d. per hour (instead of 9d. per hour as formerly) and 7d. per hour (instead of 6d.) for female workers of 20 years of age and over.

Hertfordshire. Orders fixing special overtime rates of wages for employment during the Hay and Corn Harvests of 1938. The rate for male workers of 21 years of age and over employed during the Hay Harvest is 10d. per hour, and for employment during the Corn Harvest 1s. per hour. The rate for female workers of 19 years of age and over employed during the Hay Harvest is 8d. per hour and for employment during the Corn Harvest 10d. per hour. Special overtime rates were not fixed for the Hay Harvest of 1937 but the rates for the Corn Harvest of 1937 were, for male workers of 21 years of age and over, 11d. per hour, and for female workers of 19 years of age and over 8½d. per hour.

Lincolnshire (Kesteven and Lindsey). An Order fixing special differential rates of wages for overtime employment of male workers on the Corn Harvest in 1938. In the case of male workers of 21 years of age and over the rate is 1s. 3d per hour (as in 1937).

Yorkshire (North Riding). An Order cancelling the existing minimum and overtime rates of wages and fixing fresh rates in substitution therefor, came into force on June 5, 1938, and continues in operation until November 23, 1938. The minimum rates for male workers of 21 years of age and over (other than casual workers) are 35s. (as formerly) per week of 43 hours in the weeks in which Whit Monday and August Bank Holiday fall, 52½ hours in any other week in summer, and 50 hours in any week in winter, with payment for employment in connection with the care and attendance upon animals, where the total hours exceed the number mentioned above, at 4d. (instead of 3d.) per hour for those workers who are boarded and lodged by their employer, and 7d. (instead of 6d.) per hour for those workers who are not so boarded and lodged. The differential overtime rates are 10d. per hour on weekdays and 1s. per hour on Sundays (as formerly), and 1s. per hour on Whit Monday and August Bank Holiday. The minimum rate in the case of male casual workers of 18 years of age and over is 7d. per per hour for all time worked (as formerly). In the case of female workers of 18 years of age and over, the minimum rate is 6d. per hour (as formerly)

Anglesey and Caernarvon. An Order fixing overtime rates of wages for male workers employed on harvest work during the Hay and Corn Harvests of 1938, and minimum and overtime rates of wages for male workers engaged specially for such work. The minimum rates are :—(*a*) For all male workers a differential overtime rate of 1s. per hour (instead of 10d. per hour as in 1937) ; (*b*) Workers engaged specially for work in the harvests ; Workers employed by the week or any longer period ; 44s. 6d. per week of 58 hours (as in 1937). Workers employed by the day ; for employment on weekdays other than Saturday 8s. 8d. per day of 10½ hours (as in 1937), for employment on Saturdays 5s. per day of 6 hours (as in 1937).

Denbigh and Flint. An Order fixing minimum and overtime rates of wages for male workers employed on harvest work during the Hay and Corn Harvests of 1938. The rate for overtime employment for male workers of 21 years of age and over (other than casual workers) is 1s. per hour (as in 1937). For casual workers of 21 years of age and over a minimum rate of 1s. per hour for all hours worked on harvest work is fixed (as in 1937).

Enforcement of Minimum Rates of Wages.—During the month ending June 11, 1938, legal proceedings were taken against 11 employers for failure to pay the minimum rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases follow:—

Committee Area	Court	Fines Imposed	Costs Allowed	Arrears of Wages ordered	No. of workers involved
		£ s. d.	£ s. d	£ s. d.	
Anglesey ..	Holyhead ..	1 0 0	0 5 0	18 0 0	2 (A)
Cardigan ..	Llanilar .	3 0 0	2 0 0	28 0 0	1
Durham ..	Chester-le-Street.	4 0 0	0 14 0	19 11 7½	2
Glamorgan	Pontardawe	(D)	2 6 0	1 13 9	1
Monmouth	Pontypool ..	—	1 0 0	20 0 0	1
Norfolk ..	Downham Market.	1 4 0	0 2 6	9 16 0	1
Surrey .	Guildford ..	1 0 0	0 19 6	12 18 9	2
Yorks (E.R.)	Leven .	(B)	—	—	2
Yorks (E.R.)	Leven .	1 1 0	(C)	9 15 0	1
Yorks (W.R.)	Saddleworth	2 0 0	0 8 6	41 14 5	1
Yorks (W.R.)	Wetherby	(B)	—	—	2
	TOTALS ..	13 5 0	7 15 6	161 9 6½	16

(A) = Case of 1 worker withdrawn
(B) = Dismissed.
(C) = Costs included in fine.
(D) = Dismissed under "Probation of Offenders Act"

FOOT-AND-MOUTH DISEASE

All the Infected Areas referred to in the last issue of this JOURNAL have been released from restrictions.

Three outbreaks of foot-and-mouth disease were confirmed during the period May 22 to June 21 inclusive, viz., at Garsington, Oxford, on June 2, at Staunton, Glos, on June 21, and at Redmarley, Glos, on June 22. Restrictions were imposed on areas extending to approximately 15 miles around each of the Infected Places, the counties affected being Berks, Bucks and Oxford, and Glos, Hereford and Worcs respectively.

The area around Garsington was contracted to one of approximately 5 miles radius round the Infected Place on June 17, and, if no further outbreaks are reported in the locality, it will be released from restrictions on June 24.

NOTICES OF BOOKS

The Measurement of Linkage in Heredity. By K. Mather, Ph D. Pp. 132. (London: Methuen & Co., Ltd 1938. Price 4s. 6d)

The existence of linkages between groups of hereditary factors governing bodily traits in animals and plants has long been a subject of study. This book deals with the application of statistical methods to this branch of genetics, explaining the various methods used and discussing their relative suitability for different problems The book is likely to be of considerable interest to the student, but the knowledge of statistical method and theory that is assumed is rather greater than the general reader is likely to possess

Biology in the School. By H A. Peacock, M.Sc. Pp xvi + 354 (London W. Heinemann, Ltd 1937 Price 10s. 6d)

This volume is, in effect, a text-book for the teacher of biology, dealing with the aims and methods of teaching this subject The earlier part of the book deals with general considerations, while the latter part consists of a detailed practical scheme of teaching, based on a physiological approach to the subject Chapters are also included on advanced teaching and on the teaching of biology as a subsidiary subject, also on the Natural History Society, the school museum and the library

Mr. Peacock's book is an interesting, readable, and comprehensive work on its subject, drawing on the author's considerable experience Intended primarily for the teacher, it should nevertheless prove of interest and value to all who are interested in biology or in education

Agricultural Politics, 1915–1935. By W P. Jefcock. Pp. 140 (Ipswich: W. E. Harrison & Sons 1938 Price 5s 6d)

The author refers in his Preface to Sir Herbert Matthews' book "Fifty Years of Agricultural Politics," which contained a history of the Central Chamber of Agriculture from its foundation in 1865 to the year 1915. The present book contains a record for the next 20 years of the activities of the Chamber, and the various headings under which the subject matter is grouped indicate the many aspects of agriculture that have occupied attention in recent years, and of the steps taken by the Chamber to focus agricultural opinion in regard to proposed legislation

Forschung für Volk und Nahrungsfreiheit. (Research for the People and Self-sufficiency.) Special publication No. 8 of *Der Forschungsdienst*. Pp. xii + 625. (Berlin J Neumann. 1938.)

It is impossible to appreciate the reasons for issuing this collection of 150-odd papers on agricultural sciences without understanding the functions of the four-years-old *Forschungsdienst*. This service, whose ultimate control is in the hands of the Minister of Agriculture and the Minister of Education of the German Reich, co-ordinates and administers all agricultural research, publication of scientific investigations and propaganda, extension work, and co-operation between scientific and practical men. Its function—according to its Chief, Dr Konrad Meyer, who contributes the first paper in the book—is to find the right place for agricultural science in the National Socialist State, to put it there and to keep it there. Probably the main object of these papers is to show that the *Forschungsdienst* has not wasted its time since its inception in 1934.

The external bulk of this book is a sufficient indication of the intensive research now being prosecuted with the object of increasing German self-sufficiency, its weight emphasizes the impression given by its bulk,

but there is little to be gained by looking further. The book presents a summary review of two years' agricultural publications—scarcely a mention is made of work prior to 1936 The quantity rather than quality is impressive Outstanding results in agricultural science cannot be achieved within two years, and 600 pages is too generous space for what has been achieved The feast might well have been seasoned with a little historical or even foreign sauce or, better still, it might have been greatly abbreviated without loss to the partakers

This is our World. By Paul B Sears. Pp. xi + 292, illus. (University of Oklahoma Press 1937 Price $2 50.)

Many excellent works on popular science have appeared during recent years and their number is continually being added to Most of them, however, present only a part of a greater picture Professor Sears, the author of " Deserts on the March," attempts in his latest book, " This is our World," to give a complete picture of Man and his activity in relation to his environment, past, present, and future Man is the creature of soil, vegetation, and climate, but he is becoming to an increasing degree master of his world, both for good and evil. Professor Sears shows how the material world has been conquered, and at what a cost.

Writing mainly for an American public, Professor Sears draws most of his illustrations from the great drama—almost the great tragedy—of white settlement in North America, but the lessons are of world-wide application. The destruction of natural resources that has been accomplished in the United States differs from similar destruction in other continents only in the fact that its *tempo* has been accelerated by the apparatus of modern invention.

Professor Sears shows how the complex of natural and social forces in the midst of which Man is struggling results in a culture-pattern that changes from generation to generation and from country to country For the happiness and even for the existence of the human race, the pattern must be *studied* and understood. This book, therefore, will be of great interest to all thinking people, and particularly to those who control in any way the natural resources of the countries in which they live. An application of its teaching might have laid the foundations for a happier world.

The book is written in the same pungent and lucid style that distinguishes " Deserts on the March." A number of excellent sketches by the author give a witty commentary on the text. Indeed, these alone give the gist of the story. " This is our World " should be as widely read in this country as in the United States, where it has already received a nation-wide welcome.

Danmarks Frugtsorter (The Fruit Varieties of Denmark). Edited by Professor A. Pedersen, of the Royal Veterinary and Agricultural College. (Copenhagen. Issued by Alm. dansk Gartnerforening, 1938 12 Parts each with 16 coloured plates and 64 text pages. Kr.6,50 each part. First 6 parts dealing with apples, last 6 with pears, plums, cherries, etc.)

Part I contains a very comprehensive and well illustrated account of the history and characters of the following varieties of apples. Pederstrup, Red Pigeon, Cox Pomona, Beauty of Kent, Maglemer, Boiken, Fillipa, Guldborg, Bodil Neergaard, Cox's Orange, Senderskov, Red Ananas, Signe Tillisch, Husmoder, Bismarck and Flaskeæble. It may perhaps be mentioned that the variety Mère de Ménage appears under the synonym Husmoder.

The fruit census of 1929 revealed in Denmark that there were over 10,000,000 trees of orchard fruits, mostly apples, and although there is an import trade in fruit, Denmark has actually been exporting fruit in recent years.

Prof Pedersen is a painstaking and critical author who possesses a wide practical knowledge of fruit-growing in Denmark. "Danmarks Frugtsorter" brings home very forcibly the fact that Danish farming does not only produce bacon, butter and eggs, but that fruit-growing plays a big part in a well-planned agricultural community.

Rural Trends in Depression Years, By E de S Brunner and I. Lorge. Pp. xvi + 387. (New York · Columbia University Press; London H. Milford 1937. Price 16*s* 6*d*.)

This is a report of a sociological study of 140 "village-centered agricultural communities" scattered throughout the United States, which was carried out in 1936 under the joint auspices of Columbia University and of the Bureau of Agricultural Economics of the U.S. Department of Agriculture Two previous investigations of the same committees had already been made under the same Director, in 1923–24 and in 1929–30 The present volume thus affords both a snapshot of American rural life in 1936 and a moving-picture record of its development over the previous fourteen years

The years 1930 to 1936 were of course dominated by the great depression, and the report traces the development of many phases of social life against a changing background It studies the relations between village and country, the changes in industry, trade and banking, education, social organization, religion and relief The most striking results naturally reflect the depression itself and the efforts of the population to meet it The general impoverishment is illustrated by the fact that in June, 1935, the number of persons on relief in the villages investigated was nearly 11 per cent. of their population in 1930, and that in 1933–34 one-half of all the rural teachers in the United States were receiving a salary below the "blanket-code" minimum of the N R A. for unskilled labour ($ 750). On the other hand, the economic life of the villages survived bank failures and low purchasing power The number of retail stores per village showed a remarkable increase, rising by 36 per cent in spite of a 40 per cent. fall in the value of retail sales This is no doubt a "distress" phenomenon similar in character to the increase in the number of farms. The decline in the number of banks led to an increase in the use of postal savings facilities. The co-operative movement has emerged with larger membership, but fewer individual organizations, and is extending its activities in the direction of consumers' co-operation Farmer-owned telephone companies, it is stated, have experienced far fewer disconnections than occurred in the areas where the Bell system had a monopoly—an interesting commentary on the difference in the scope of British and American co-operative organization.

Since the investigation was an extensive rather than an intensive one, the book does not attempt to present that intimate picture of an individual community, which has made some other studies of the same type so absorbing. It is nevertheless an important contribution to the contemporary social history of America.

Australia's Entail. By A O. Barrett Pp 205, illust (Melbourne. Robertson & Mullens, Ltd 1937 Price 6*s*)

With the problem of soil erosion assuming such importance in countries with a prolonged seasonal drought, and claiming as it does the attention of botanists and foresters throughout the world, the publication of this

little book is particularly opportune. In addition, Australia has its own particular problems associated with salinity of soil and much reduced regeneration owing to the ravages of the rabbit, thus the subject of practical œcology is one of increasing importance Anything therefore contributing to the conservation of soil and preservation of vegetation is extremely valuable in Australia Indeed in few other countries is the denudation of the soil attended by such devastation. Mr. Barrett's book makes very interesting reading, and there are several highly original theories propounded which, even though not acceptable to all œcologists, nevertheless contain much that is based on original observation. Of particular interest are those observations relating to Eucalyptus trees and watersheds

The volume consists of 200 pages divided into three books, dealing with the soil, trees and rainfall, and finally an account of some experiments concerning temperature fluctuations in the heartwood of *Pinus canariensis*, and the seasonal sap flow in *Eucalyptus botryoides*, the latter compiled in collaboration with Heber Green.

Unlike most books dealing with soil problems and arboriculture, the subjects are discussed in a colloquial style, unfortunately inclined to lapse into grammatical errors The book is one, however, that has an appeal to all who are interested in the land

Fruit. A Summary of Figures of Production and Trade relating to Apples, Pears, Bananas, Citrus Fruit, Grapes, Wine, Raisins and Currants and Canned Fruit Obtainable from H M Stationery Office, Adastral House, Kingsway, London, W C 2 Price 2*s* 6*d*., post free 2*s*. 8*d*.

This report of the Imperial Economic Committee deals with its annual summary of the world production of, and trade in the principal kinds of fresh, canned and dried fruit. For a number of the fruits, separate sections are devoted to acreage and production, exports, the trade of the Empire as a unit, imports into the principal countries and into the United Kingdom in particular An Appendix to the review contains particulars of the duties and trade restrictions in force in certain European countries as at September 30, 1937 The summary covers the period 1930—1936, and it will be useful to those interested in the fruit trade of this country and in an expanding Empire industry

Complete production statistics are not available It appears that the general tendency has been one of expansion more especially in those countries which grow fruit for export, but the production of lemons, grapes and bananas has shown no appreciable expansion in recent years

The review shows that the United Kingdom continues to be the world's largest importer of fruit and is the chief market for apples, pears, raisins, currants, oranges and grape fruit The importance of the United Kingdom in the fruit market is realized from the fact that Germany, which is the second largest importer of fruit, takes less than half the quantities imported into the United Kingdom of apples, pears and oranges.

The heavy imports into the United Kingdom make the British Empire, as a unit, a net importer of all fruits dealt with in the report except bananas, but the development in the export trade of the Dominions in recent years has considerably reduced the import balance

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NOTES FOR THE MONTH

Grain Crops

The latest issue of the annual review, prepared by the Imperial Economic Committee and published by H.M. Stationery Office, shows how rapidly conditions in the world market for wheat have changed in recent years.

The world's visible stocks of wheat totalled over 32 million tons at the end of the 1933-34 season. From this peak they had been so much diminished by August, 1937, that the total of 14½ million tons was the smallest figure for over ten years. Prices rose sharply in 1936-37 with the fall in supplies, and farmers all over the world sowed an appreciably larger area with wheat for the 1937-38 crop than in the previous season. Though there was not a proportional increase in the world production of wheat (excluding Russia and China), nevertheless the harvest was larger than in any of the three preceding seasons. Consequently, stocks this August are expected to show an increase of some 2 million tons over last year, much of this increase occurring in the United States, where the wheat crop in 1937 was bigger than at any harvest since 1931. Stocks in Canada and Argentina are unlikely to differ much from the totals recorded in August, 1937, for in both countries the last crop was small, as a result of drought and frost damage respectively.

The United States, now having bountiful supplies in the current 1937-38 season, has resumed its old position as a wheat exporter, whereas in the previous season it was importing heavily. The Soviet Union has increased it exports, whilst Australia also has larger supplies available. On the other hand, both Canada and Argentina have only a small exportable surplus. Last season Italy and Germany were large importers.

This season Germany has again been importing on a considerable scale. Italy's immediate import requirements were less because of the large harvest reaped in 1937. In some parts of Europe, notably in Italy, the harvest from the 1938 crop is likely to be comparatively small, due to adverse weather this spring. Larger imports may therefore be necessary. In the Far East hostilities have curtailed imports.

As to the future position, the review draws attention to the fact that in few parts of the world has there been any indication that the area devoted to wheat for the 1938-39 crop will be substantially reduced as compared with the last sowings. Since last autumn the price of wheat has shown a downward trend, and recently the decline has been rapid, due very largely to the prospect of a bumper harvest in the United States this year. It is too early yet to judge what the final outturn will be, but it seems that the world crop, providing the harvests are normal, may be substantially larger than the demand, even if the European demand is stimulated by Government purchases to build up reserves of wheat against possible emergency needs.

The review also covers barley, oats, maize, rye and rice. It forms a convenient source of information on world cereal production and trade in the years 1930-37 and particularly on the part played by British Empire countries. Special sections deal with the net trading position of the Empire, imports into the United Kingdom, the trend of prices, and on customs duties and import restriction in the chief European importing countries.

The report is obtainable through any bookseller or from H.M. Stationery Office, price 2*s.* 6*d.* (by post, 2*s.* 8*d.*).

Control of Potato Blight by Copper Fungicides

During the last few seasons field experiments have been in progress at the Kirton Agricultural Institute to determine the best type of copper fungicide for use in the control of potato blight. Dusting, or " dry spraying " as it is called locally, is the most widely practised method of blight control in Lincolnshire, and the experiments were designed to ascertain the optimum copper content of a dust and the fungicidal value of dusts prepared by different methods. Full details of the tests will be published later, but in the meantime the JOURNAL is indebted to Mr. J. K. Thompson, Assistant Agricultural

Organizer of the Agricultural Institute, Kirton, for the following brief statement of the results obtained in the tests on the copper content of dusts.

The trials have shown that no dust with a copper content of less than 15 per cent. metallic copper has afforded adequate protection, no matter what the fineness of division of the dust might be. In the 1936 tests a dust containing 20 per cent. of metallic copper proved significantly better than all others and the control, but in the 1937 tests the differences in yield between the plots treated with dusts containing 15 per cent., 20 per cent., and 24 per cent. of metallic copper were not significant. The yields from the treated plots were all significantly better than the yields from the control plots.

In both seasons the dusting programme was based on the principle of maintaining a cover of fungicide on the foliage of the plants over all critical periods. This involved frequent applications, thirteen being given in 1936 and nine in 1937. Costs were recorded for the experiments in both seasons, and it was found that the increased yields obtained from the treated plots more than paid for the outlay on dusts and labour. The importance of frequent application for effective control, and the advantage of dusting early in the morning, while the dew is still on the leaves, are emphasized.

Dairy Floors and Sinks

Floors. Concrete floors in dairies, creameries, and cheese factories are subjected to severe wearing by heavy abrasion and the constant impact of milk churns, and, in addition to direct chemical attack by the lactic acid and fat present in milk and whey. Whilst it is usually impracticable to eliminate entirely the action of acids and fat, their effect may be reduced to a minimum if care is taken to remove them as soon as possible, and it is therefore very important to have sufficient fall on all floors to ensure rapid and reasonably complete drainage. The practice of sprinkling powdered detergent on greasy floors and leaving overnight before cleansing should be avoided.

The use of a suitable rubber mat on the unloading platform is effective in reducing abrasive action and at the same time prolongs the life of the churns.

It would appear that the success of a dairy floor depends as much on the impermeability of the concrete as on the merits

of any special surfacing which may be used. It is, therefore, important to ensure that only suitable aggregates are employed in the correct proportion to ensure dense, impervious concrete. The topping coat should be of adequate thickness and be laid while the sub-floor concrete is green.

The sub-floor should consist of Portland cement concrete in the proportion of 1 part cement, 2 parts clean sharp sand and 5 parts suitable aggregate graded up to, but not exceeding, 1½ in. in any direction. A topping containing Portland cement and clean granite chippings graded up to ⅜ in. in the proportion of 1 to 2 has given satisfactory results. This topping would probably be improved by the addition of some proprietary material having wear and water resisting properties.

In places subjected to considerable wear from the rolling of churns, the most successful floor is made of perforated cast-iron grids or plates approximately 12 in. square and 1½ in. thick, laid and filled in with granolithic in the proportion of 1 part Portland cement to 4 parts ¼ in. granite chippings. The holes are sufficiently small to make the iron take most of the wear. Advice on the composition and special treatments of concrete may be obtained from the Cement and Concrete Association, 52, Grosvenor Gardens, London, S.W.1.

Sinks. It has long been a practice in Stilton cheese factories to use red lead as a jointing material for porcelain sinks, as the normal Portland cement joints deteriorate rapidly.

It is suggested that as a trial the sinks should be jointed with Portland cement, and the joint raked back for ⅜-½ in. and filled in with sodium silicate (water-glass) cement. The joint should be as thin as practicable. The sodium silicate solution used should have a molecular ratio of $SiO_2 : Na_2O$ not less than 3 : 1, and a density around 1.35. It should be mixed with an aggregate of fine pumice or ground brick to form a paste. The hardening of the joint may be accelerated by brushing over the surface, after it has dried, with a 10 per cent. solution of calcium chloride, and this would probably be desirable as otherwise hardening depends on absorption of atmospheric carbon dioxide. The joint must, of course, be allowed to harden before the tanks are used. Alternatively, there are various proprietary cements of this class which could conveniently be used, and, although some of these contain silico-fluorides, it is not considered that any contamination of the cheese will result from their use.

Agricultural Research Council

The third Report of the Agricultural Research Council surveys the research work aided from State sources during the period October 1, 1935, to September 30, 1937, on the breeding, nutrition and diseases of crops and farm animals, on soils, on agricultural engineering and agricultural economics, and on dairying.

The Council now possesses a field station of its own and employs its own research officers, both at the field station and in existing research institutions.

The Council's new Field Station is situated at Compton, in Berkshire, where it is proposed to establish disease-free herds of cattle, pigs, etc., and to provide opportunities for experiments under scientifically controlled conditions on a larger scale than is ordinarily possible at any individual research institute. With cattle, the first group of experiments will be concerned with Contagious Abortion and will involve the testing of various vaccines which, as the result of the current work on the disease at the research institutes, appear to merit full scale trial.

The Council is evidently as disturbed as the farming community at the unduly high death-rate in pigs and poultry. Apart from deaths due to infectious diseases, serious losses occur in little pigs from complex causes—nutritional, hereditary, hygienic—and both at the Compton Field Station and elsewhere work has been commenced to find how these losses may be reduced.

A technical Committee of the Council has given much study to Fowl Paralysis, research on which, under the co-ordination of the Committee, is throwing new light on both the hereditary and infectious aspects of the disease and should mark an important advance towards its understanding and ultimately its control.

A survey of sheep diseases in Great Britain, especially those due to anaerobic bacilli, has been carried out by a scientific officer appointed by the Council and has given much valuable information on the prevalence of particular diseases in different parts of the country. Malnutrition has been found to be a serious problem, especially in parts of Scotland. Vaccination against louping ill, based on extensive tests carried out by the Animal Diseases Research Association at Moredun in Scotland, is extensively practised with satisfactory results. Vaccination has also been shown to be an efficient preventive

of braxy, and lamb dysentery, another locally serious disorder, can be prevented by serum therapy. Work on sheep blowflies is is progress in Wales and Scotland and has shown that the blowfly is attracted by certain conditions of the skin and fleece. Management to avoid these, together with the use of dips, repellents and poison baits, are useful means of control.

The recent outbreaks of Foot-and-Mouth Disease rendered timely a review of the research work on this disease undertaken by the Council in 1937. The general conclusion was that, in spite of the considerable cost and slow progress of the investigations, the right course was to pursue them, in the hope that measures might eventually be found which would make possible a modification of the slaughter policy now enforced. Proposals were made for strengthening the scientific control of the work and expediting its progress, and these have been, or are being, put into effect.

A new interest of the Council in the field of animal disease was marked by the setting up of an equine research committee to initiate and control work on horses, mainly on their diseases, for which substantial aid is being provided by the Racecourse Betting Control Board.

A general survey of dairying research in Great Britain was made by the Council's Dairying Committee and the recently published Report of this Committee has already received notice. Another extensive review was carried out by a special Sub-Committee on Soil Surveys and led to a recommendation for some expansion of the existing limited organization to enable a systematic survey of the soils of Great Britain to be carried out. A service of this kind would help in agricultural planning for the proper utilization of the soil and might be very valuable in an emergency.

In discussing the work of the Council's Helminths Committee, accounts are given of research on worm parasites of farm animals and of crops. The influence of diet on worm infestation of sheep is under study at the Rowett Research Institute, and the Lecturer in Agricultural Zoology at the North of Scotland Agricultural College has co-operated in this study. Investigations aided by the Council on the potato eelworm are giving valuable information on the methods of reducing the eelworms present in the soil by the growing of certain crops, by rotation and by the use of chemicals. At the Institute of Agricultural Parasitology two varieties of oats have

been found which show resistance to the attack of the " tulip root " eelworm. Somewhat similar work on the control of wireworms has been developed at Rothamsted and Manchester.

Among other Research Institutes dealt with in this report mention may be made of Long Ashton, where the most interesting development is in research into the preparation of apple and other fruit juices, for which there is an increasing demand. Rothamsted is experimenting on methods of increasing the supply of organic material in the soil in view of the shortage of farmyard manure on mechanized farms. The increasing importance of green and other vegetables in farming economy and the development of the glasshouse industry and the growing of flowers for the market has led to the appointment of a Committee of the Council and the Agricultural Departments, which is considering the extension of research on these crops.

In the field of agricultural engineering the Council's main interest during the past few years has been in grass drying, and a brief review of the position of this new development shows that there were about 75 centres engaged in grass drying in 1937 and describes the machines in use and the cost of the process. Improvement in the efficiency of the dryers and more experience in the management of the land for grass drying are amongst the chief requirements for determining the potentialities and limitations of this method of avoiding the waste in allowing grass to run on to hay.

Tuberculosis (Attested Herds) Scheme, 1938

Under the powers conferred upon him by Section 20 of the Agriculture Act, 1937, the Minister has made the Tuberculosis (Attested Herds) Scheme, 1938, incorporating with certain modifications the Schemes hitherto in operation in England and Wales, and Scotland, respectively, and extending their scope to include herds other than those of registered milk producers which alone were previously eligible for attestation.

The new Scheme, which came into operation on July 1, 1938, continues the bonus of 1*d.* per gal. on the milk sold from an Attested Herd under the provisions of a milk marketing scheme, extends the bonus to milk used for the manufacture on the farm of cheese the sale of which is approved for payment by a milk marketing board under any Scheme or Agreement they may have with farmhouse cheese-

makers, and provides, as an alternative to milk bonus, a bonus on the cattle in the herd at the rate of 10s. per head at half-yearly intervals, subject to a maximum of six half-yearly payments. The owner of an Attested Herd may elect to receive either milk bonus or the alternative head-rate bonus.

The conditions that a herd must satisfy before a Certificate of Attestation may be granted and the herd entered in the Register of Attested Herds kept and published by the Minister, remain as heretofore, viz., the management of the herd and the conditions in which it is kept must be suitable for the observance of the Rules applicable to Attested Herds, and the herd must pass an official tuberculin test, carried out free of charge to the owner by a veterinary inspector of the Ministry, which is only applied after the herd has passed two consecutive herd tests carried out by the owner's veterinary surgeon without any reactors being found.

If at a herd tuberculin test carried out by the owner's veterinary surgeon the number of reactors does not exceed a certain specified proportion (about ten per cent.), the owner may apply to the Minister for financial assistance towards the cost of further tests (up to a maximum of four complete herd tests), to be carried out at intervals of from 60 to 90 days, with a view to completing the eradication of tuberculosis from his herd and applying for a Certificate of Attestation. The contribution payable in respect of each of the "assisted" herd tests is at the maximum rate of 2*s*. 6*d*. per head of cattle tested plus a sum of £1 1*s*. 0*d*. per herd, but the contribution will in no instance exceed the charge made by the veterinary surgeon for carrying out the test.

If a herd fails to pass the official test required before a Certificate of Attestation can be issued, the owner has the opportunity of applying for further official tests at the Minister's expense up to a maximum of three complete herd tests (making four official tests in all). Where the whole herd has passed one of these tests a Certificate of Attestation will be granted.

Herds that have been accepted for "assisted" tests or for additional official tests, mentioned in the two preceding paragraphs, are known as "Supervised" herds and their owners are required to observe certain Rules, dispose of reactors, and disinfect the part of the premises occupied by reactors. These Rules differ somewhat from those applicable to Attested Herds, but are designed with the same object,

viz., to protect the herd from the risk of infection by contact with cattle that are on adjoining premises or that may be added to the herd.

During the past twelve months, the Attested Herd Schemes have made considerable progress. On July 1, 1938, there were 2,690 Attested Herds in Great Britain, while well over 2,000 additional herds were undergoing "assisted" tests or were awaiting official test. It is anticipated that the new Scheme will make a wide appeal to owners of herds to which the benefits of attestation are now extended, and will thus further the campaign against tuberculosis inaugurated under the Agriculture Act, 1937.

Copies of the Scheme, and of forms of application for a Certificate of Attestation or for financial assistance towards the cost of tuberculin testing under the arrangements outlined above, may be obtained by herd owners in England or Wales from the Secretary, Ministry of Agriculture and Fisheries, Whitehall Place, London, S.W.1, and by herd owners in Scotland from the Secretary, Ministry of Agriculture and Fisheries (Animal Health Division, Scottish Branch), 15, Moray Place, Edinburgh, 3.

Progress of the Land Fertility Scheme

At June 30, contribution had been made in respect of over 200,000 applications for contribution under the Land Fertility Scheme, received from occupiers of agricultural land in the United Kingdom, sums amounting to £800,000 having been paid in respect of lime, and £240,000 as regards basic slag. The number of applications for contribution received at June 30 was 220,000. These applications represented 1,369,000 tons of lime, and 429,000 tons of basic slag.

AGRICULTURAL POLICY

I.—MILK

On June 22 the Minister of Agriculture and Fisheries, in reply to a question in Parliament by the Rt. Hon. A. V. Alexander, M.P., announced that owing to the pressure on Parliamentary time it would not be possible for legislation to give effect to the Government's proposals contained in the White Paper on Milk Policy (Cmd. 5533)* issued in July, 1937, to be introduced and considered during the current session. The Government hoped, however, to introduce such legislation early in the next session and, as an interim measure, proposed to ask Parliament to pass a Bill to extend the chief provisions of the Milk Acts, 1934 to 1937, for a further twelve months until September 30, 1939.

The Minister also said that the Government had decided to include in the interim Bill provision for the following matters:—

1. Release of Milk Marketing Boards from Liability to Make Repayments.—As announced in paragraph 8 of the White Paper it was proposed to release Milk Marketing Boards from liability accruing after September 30, 1937, to repay to the Exchequer the advances made under the Milk Acts in respect of manufacturing milk.

2. Extension of Cheap Milk Schemes.—An extension of Section 11 of the 1934 Act would enable Exchequer contributions to be made towards the cost of the schemes referred to in paragraphs 20 and 21 of the White Paper, namely, cheap milk for school children and expectant and nursing mothers and for children under school age, and, in order to facilitate the development of these schemes, Parliament would be asked to provide an additional £750,000 (i.e. £250,000 more than the £500,000 hitherto made available annually).

The Milk (Extension and Amendment) Bill was subsequently introduced to give effect to the above proposals and has now received the Royal Assent.

Premiums on Quality Milks: Minister's Statement

During the debate on the Second Reading of the Milk (Extension and Amendment) Bill on July 4, the Minister stated that it had been represented to the Secretary of State for Scotland and himself that many milk producers had, during the previous year, incurred expenses in bringing their herds and methods of milk production up to "attested" or "designated" milk standards in the anticipation that the increased premiums set out in the White Paper would become operative as from October, 1938, as had been originally intended. He said that the proposed Exchequer assistance

* Reproduced in the September, 1937, issue of this Journal (p. 525).

towards these increased premiums was one feature of a comprehensive and balanced policy containing other proposals of equal importance; it was essential, in the Government's view, that these proposals should be enacted substantially as a whole. Accordingly, the Government were unwilling to provide in the extending Act for Exchequer assistance to be given towards the payment of increased premiums on quality milks, as this course would involve an anticipation of one part only of the Government's policy. The Minister announced, however, that, if Milk Marketing Boards should decide as from October 1, 1938, to pay increased premiums and allow increased rebates for quality milks on scales approved by Ministers and corresponding to those foreshadowed in the White Paper, the Government would be willing to commend to Parliament, as part of the forthcoming legislation, a provision authorizing retrospective assistance from the Exchequer with a view to putting Milk Marketing Boards in the same financial position as regards Exchequer assistance from October 1, 1938, as they would have been in if the long-term legislation had been passed during the 1937-38 session.

II.—POULTRY

The following statement was made by the Minister in reply to a question in the House of Commons on July 11, 1938:—

"The Government have given very careful consideration to the position of the poultry industry in all its aspects. They have had before them the reports of the Reorganization Commissions for Eggs and Poultry, the report of the Poultry Technical Committee and the provisional proposals drawn up by the leading producers' organizations for a marketing scheme under the Agricultural Marketing Acts. They have also taken into consideration the results of recent consultations with representatives of organizations of producers and distributors.

"Following a period of rapid expansion after the War, the industry has experienced an appreciable decline in the last three years. That decline appears to have been due to several factors, and the Government accept the view of the Poultry Technical Committee that one of the most vital factors affecting the prosperity of the industry in the whole of Great Britain at the present time is the high incidence of mortality in poultry flocks. The Government are impressed by the Committee's views as to the very serious and urgent nature of the disease problem in the poultry industry, and they

agree substantially with the recommendations of the Committee as to the manner in which the problem should be tackled.

"The Government accordingly propose that a Poultry Commission for Great Britain should be set up with power to control the distribution of breeding stock, hatching eggs and day-old chicks; and with the responsibility of conducting a stock improvement scheme on voluntary lines, assisted by premiums from the Exchequer on a diminishing scale. In addition the Government are prepared to facilitate the establishment of a research station for the investigation of the major disease problems of the industry; to give sympathetic consideration to a scheme, which the Commission will be asked to prepare, for the establishment of a progeny-testing station with a view to the production of the highest quality foundation stock; and to co-operate in making increased provision for educational and advisory work among poultry producers. The proposal for a poultry research station is already under consideration by the Agricultural Research Council.

"The Government are of the opinion that another factor contributing to the present difficulties of the industry is the lack of organization in the marketing of home-produced eggs and poultry. This problem was dealt with in the Reports of the Reorganization Commissions appointed under the Agricultural Marketing Acts in 1933, and has since been discussed at length by the leading organizations of producers. The proposals provisionally submitted by the English organizations in December last envisaged the promotion of a statutory marketing scheme, the main object of which would be the regulation of the marketing of eggs by the standardization of grading and packing.

"There appears to be general agreement among the organizations representing both producers and distributors that some improvement in the present methods of marketing home produced eggs is needed. Such a large proportion of individual poultry-keepers are in a small way of business, however, that the regulation of marketing under a producers' marketing scheme would present a very formidable task; moreover, it is doubtful whether a producers' marketing scheme would be the most effective, or indeed, the most appropriate, machinery for securing, for example, the standardization of grades, since this is an object which necessarily involves the regulation of marketing practices in the wholesale and retail distributive trades. As an alternative to action by

producers under the Agricultural Marketing Acts, therefore, the Government propose that the Poultry Commission should be given power to regulate the marketing of eggs, and also of dead poultry by the standardization of grades, etc., up to the point of final sale to the consumer.

"In connexion with this proposal for marketing reform, the Government are prepared to ask Parliament to provide a limited sum of money by way of loans to facilitate the establishment of producers' co-operative egg packing stations and by way of grants for the demonstration of efficient methods of packing dead poultry.

"Careful consideration has been given to the claims of the industry that the existing tariff protection against imports from foreign sources should be supplemented by direct financial assistance in the form of an Exchequer subsidy, whether to offset the present high cost of feeding stuffs or to provide in effect a guaranteed minimum price for eggs in the flush season. The Government are satisfied, however, that a subsidy for egg production would not only involve very serious administrative difficulties but would not be likely in the long run to be to the advantage of the industry as a whole. The Government do not propose, therefore, to invite Parliament to make provision for the payment of a subsidy.

"On the other hand, the Government recognize that the quantitative regulation of imports of eggs and poultry may be necessary in certain circumstances. The Government are not prepared to restrict imports for the purpose of raising the normal levels of prices; only an increasingly drastic restriction of imports of eggs would effect and maintain (and then only for a limited period) any appreciable rise in prices. The Government feel, however, that if the task of establishing the poultry industry in Great Britain on a firm foundation is to be undertaken with energy and confidence, the industry should be safeguarded against possible dislocation of the market resulting from abnormal arrivals from overseas. They propose accordingly to seek power to regulate imports of eggs and other poultry products in the event of such a danger arising. Power will also be sought to regulate imports, if necessary, in conjunction with, and in support of, any organized operations that may be undertaken by the industry, by storage during the spring flush, with a view to modifying the extreme seasonal variations of supplies and prices. The Government commend these proposals as a policy which will

materially assist the poultry industry by enabling effective steps to be taken to secure an all-round improvement in the quality of breeding stock and to reduce the heavy and increasing loss from disease, a loss which has been estimated at no less than £4 million a year for adult laying-birds in England and Wales alone; and by facilitating reforms which should lead to greater efficiency and economy in the marketing field.

"Legislation to give effect to these proposals will be introduced as soon as possible."

THE MANUFACTURE OF HUMUS BY THE INDORE PROCESS

SIR ALBERT HOWARD, C.I.E.,

Formerly Director of the Institute of Plant Industry, Indore, and Agricultural Adviser to States in Central India and Rajputana

During the fifty-nine years which have elapsed since the great depression of 1879, a well marked change in the agriculture of Great Britain has taken place. The old mixed farming of the eighteen-seventies has passed away; the arable area has steadily diminished; the area under permanent pasture has increased while, generally speaking, there are far fewer sheep, cattle and horses than there used to be. There is now much less farmyard manure made on the land than was the rule sixty years ago. Since the Great War the supply of dung from horses which were maintained in the cities has shrunk to almost nothing. The result of these changes has been to upset and to destroy the old well-tried balance between crops and stock; there is a general shortage of humus in the soil; soil fertility has decreased. One of the great problems of British agriculture, therefore, is how best to restore and then to maintain this vanished fertility at a reasonable cost and so put the fields of this island into better heart. The object of this article is to suggest a possible solution of this problem by the simple process of the manufacture, on every farm, of the necessary humus from the various agricultural and urban residues now largely running to waste. This is being done successfully at a few centres in Great Britain by means of the Indore Process.

The Original Indore Process. The Indore Process is a composting method which was originally developed for the benefit of the cotton growers of India. It was described in book form under the title *The Waste Products of Agriculture,* and published by the Oxford University Press in 1931. The method follows the natural production of humus from mixed vegetable and animal wastes which is going on continuously on the floor of every forest and every piece of woodland by the oxidation processes associated with fungi and bacteria.

In the original technique devised for the small-holders of India, the mixed and partly withered vegetable wastes were assembled in heaps or in pits to a total depth of about 3 ft.

in layers each about 6 in. thick, moistened with a slurry made from urine-impregnated earth (taken from the floor of the cattle shed) and all the wood ashes available. The mixed vegetable wastes were not continuous, but were separated by a thin layer of farmyard manure about 2 in. deep. In this way an intimate mixture of vegetable and animal wastes ready for fermentation was secured without any loss of urine—the most important portion of the waste products of the animal. At the same time a base for neutralizing excessive acidity during the subsequent fermentation was provided by the wood ashes and soil. Arrangements were made for keeping the mass moist by suitable methods of watering: the large quantities of oxygen needed were obtained by diffusion from the atmosphere. For this purpose the materials were always assembled loosely, trampling was avoided, and the total depth of the fermenting mass never exceeded 30 in. after the contents of the heaps or pits had sunk.

An intense fermentation accompanied by a rapid rise in temperature to about 145°F. takes place, which continues for a long time with only a moderate downward gradient to about 85°F. after ninety days. This range fits in well with the optimum temperature conditions required for the organisms which break down cellulose. The aerobic thermophyllic bacteria thrive best between 110°F. and 145°F.; the fungi between 100°F. and 130°F.

Sixteen days after charge the pits or heaps are turned from one end, care being taken to place the outside layers into the middle of the new heap. A second turning in the reverse direction takes place one month after charge; the third and last turning two months after the commencement of operations, when the material is left to ripen for another month before being applied to the land in a form resembling finely divided leaf mould, of which about 80 per cent. passes through a sieve of six meshes to the linear inch. Compost should always be judged by fineness: chemical analyses are unnecessary.

In this way all the wastes of the average Indian holding could be converted into humus with an actual gain of nitrogen —by fixation from the air during the ripening process—sometimes as high as 25 per cent.

An essential factor in the original technique was the use of the urine and dung of the work cattle for providing the food materials of the organisms which manufacture humus.

In the many applications of the method to other countries which have taken place since 1931, the use of animal wastes, particularly urine, has always been insisted upon, not because these are the only activators available, but because (1) the verdict given by Mother Earth between humus made with animal wastes and by the use of chemical activators has always been in favour of the former, and, (2) no permanent and effective system of agriculture has ever been devised without live stock. Any change in manuring for the purpose of raising the humus content of the soil must therefore conform to the old and well-tried agricultural principle that it is impossible to farm for long without animals.

Adoption of the Process by the Plantation Industries. The adoption of the Indore Process all over the world has been very rapid. By the end of 1933 practically every coffee estate in Kenya and Tanganyika was busily engaged in the conversion of all its available wastes into humus. The tea industry rapidly followed suit. After the first year's trial of the process was completed in October, 1934, on one estate in the High Range, Travancore, progress has been spectacular. At the moment, over 1,000,000 tons of humus a year are being made on the tea estates in India and Ceylon alone. Other plantation industries, such as rubber, sisal, cotton, maize, rice, coconuts, cacao and sugar, are adopting the method. Another active composting centre is South Africa, where the *Farmers' Weekly* of Bloemfontein has done much to bring the Indore Process to the notice of the farming community. These applications are by no means confined to the British Empire. Detailed accounts of the Indore Process have been published in German and Spanish: both have led to interesting developments. In Latin America especially the Indore Process has aroused the very greatest interest; there has been a constant supply of literature in Spanish to meet the increasing demand; a large number of coffee and other estates have adopted the method. I am informed on the best authority that the Indore Process has come to stay in the New World.

In the course of this work one matter of the greatest interest to agriculture has developed, namely, the relation between the increased soil fertility which follows the application of freshly prepared humus (made from vegetable *and* animal wastes) and resistance to disease. In tea, for example, the addition of humus at 5 tons to the acre has resulted in a sudden

and well marked improvement in the general health of the bushes. During a recent tour to tea estates in the Orient, I have myself observed these results and have discussed them with the men on the spot who have obtained them. The explanation is interesting. An examination of the root system of areas of similar tea (one of which had been treated with humus, the other having been left unmanured as a control) showed that humus alters the absorbing root system and brings about the formation of numerous tufts of healthy roots in which the mycorrhizal relationship is well established. In practically every instance manuring with humus was followed by improved growth and increased disease resistance. Whenever these results were obtained, there was a corresponding development of mycorrhiza. Where artificials had been employed, this condition was either absent or only occurred sporadically.

Adaptation of the Indore Process to Conditions in Great Britain. Any project for the improvement of agriculture in this country must conform to two conditions : (1) the shortage and dearness of labour; (2) the need of making both ends meet. Any new proposal must be practicable: it must also pay its way. One way of investigating such a matter is to get a few of the live wires among the farming community to try out any possible improvement and then to watch the results. If the trials lead to the adoption of the innovation, there is nothing more to be said: all valid objections have been answered automatically. The large-scale trials of the Indore Process which have recently been carried out in Great Britain have passed this test. What is needed now is to seek out all the live wires in the country and to get them to copy the work of the pioneers.

MARKET GARDENING. The first and most complete trial of the Indore Process in Great Britain was carried out by Captain R. G. M. Wilson at the Iceni Nurseries, Surfleet, Lincolnshire. The work commenced in December, 1935, and can best be described in Captain Wilson's own words taken from a Memorandum he drew up for the members of the British Association who visited his farm on September 4, 1937.

"The Iceni Estate consists of about 325 acres comprised as follows.—

Arable land, etc	225 acres
Permanent grass land	30 ,,
Rough wash grazings	35 ,,
Land under intensive horticulture	35 ,,

The main idea in the development of the estate has been to prove that even to-day, in certain selected areas of England, it is a commercial proposition to take over land which has been badly farmed, and bring it back to a high state of fertility, employing a large number of persons per acre.

To this end the estate has been developed as a complete agricultural unit with a proper proportion of live stock, arable land, grass land and horticulture, with the belief that after a few years of proper management the estate can become very nearly, if not entirely, a self-supporting unit, independent of outside supplies of chemical manures, etc., and feeding stuffs, the land being kept in a high state of fertility, which is quite unusual to-day, by:—

(1) A proper balance of cropping
(2) The conversion of all wheat straw into manure in the crew yards and the utilization of this manure and as much as possible of the waste products of the land for making humus for the soil.

As regards (2), the method of humus making which has been employed is known as "The Indore Process," and it has proved remarkably successful The output in 1936 amounted to approximately 700 tons, and in the current year will probably be about 1,000 tons

As a result of this utilization of humus, the land under intensive cultivation has already reached a state of independence, and for the last two years *no chemicals have been used in the gardens at all either as fertilizers or as sprays for disease and pest control.* The only wash which has been used on the fruit trees is one application each winter of lime sulphur, and it is hoped to eliminate this before long

The farm land is not yet independent of the purchase of fertilizers, but the amount used has been steadily reduced from 106 tons used in 1932, costing £675, to 40½ tons in the current year, costing £281 Similarly the potato crop, which formerly was sprayed four or five times, is now only sprayed once, and this it is hoped, will also be dispensed with before many years when the land has become healthy and in a proper state of fertility

Eventually, with a properly balanced crop rotation, there is no doubt in my mind that the same degree of independence can be reached on the farm as has already been attained on my market garden land

The probable cropping will eventually work out as follows —

75 acres potatoes.
75 acres wheat
25 acres barley, oats, beans and linseed (for stock feeding).
15 acres roots (for stock feeding)
30 acres one year clover and ryegrass leys for feeding with pigs and poultry and cutting for hay, ploughing in the aftermath

The live stock carried on the farm at the June returns was as follows:—

22 cattle (cows and young stock of my own breeding)
14 horses (including foals).
15 sows (for breeding).
103 other pigs.
120 laying hens (of my own stock)

And although it is rather early to say, I believe that the above figures may be about right for the size of the farm, with the addition of about 20 cattle for winter yard feeding. This latter importation will be rendered unnecessary in a few years when the number of cattle of my own breeding will have increased."

Since this Memorandum was written, Captain Wilson has pipe-drained the area of 35 acres devoted to intensive horticulture. I have recently (July 1, 1938) re-visited the Iceni Nurseries and am convinced that still further progress has been made on the farm and in the garden. The potato crops grown with organic manure and humus only are most impressive. I have never before seen such healthy potatoes in South Lincolnshire. Here is a definite example where the establishment of nature's equilibrium between the soil, the plant and the animal has resulted in increased crops, in higher quality produce and in a marked improvement in disease resistance.

MIXED FARMING. To meet the objection that mixed farming carried on as a subsidiary to market gardening is not representative of British agriculture, the Indore Process has been tried out by Sir Bernard Greenwell, Bart., on his Surrey and Suffolk estates on an area of about 13,000 acres devoted to mixed farming. In order to provide the raw material needed for composting the large quantity of farmyard manure produced on his land, Sir Bernard has made use of a considerable volume of crushed urban wastes from Southwark. These materials when composted with ordinary farmyard manure have yielded a product which, load for load, is producing crops as good as those obtained with ordinary farmyard manure.

HOPS. A very valuable source of manure for the hop crop is the bine and string left after the hops are picked. Much of this is now burnt in order to destroy any noxious insects or fungi which may be carried by this material. As no diseased residues were ever destroyed at the Institute of Plant Industry at Indore but were always converted into humus without any case of disease following such applications, it occurred to me that similar results would be obtained by the composting of hop bines and hop string in this country. Such a trial has been successfully completed on one of the largest hop gardens in Great Britain, at Bodiam in Sussex, the property of Messrs. Arthur Guinness, Son and Co., Ltd. An excellent compost has been made from crushed dustbin refuse from Southwark and hop bine cut up into short lengths. No outbreaks of insect or fungus pests have followed the use of this compost.

OTHER TRIALS. Similar results to those described have

been obtained on land devoted to fruit, to vegetable and flower growing, potato cultivation and to private gardens. During the coming year I propose to collect all this scattered information and to record the various results. In no instance has the application of humus been followed by any outbreak of insect or fungus disease—a negative result which since the publication of *The Waste Products of Agriculture* in 1931 has remained unbroken all over the world. The positive feature of these trials has been an improvement of the crop in yield, in quality and in resistance to disease.

Sheet Composting. In a number of instances in this country it is not practicable to collect vegetable wastes for composting in heaps or in pits. The available material is scattered over a large area in the shape of catch crops, green-manure, weeds or the turf of worn-out grass land and of old temporary leys. In all these the wastes can be converted into humus *in situ* provided they are manured with farmyard manure or compost and ploughed in while there is sufficient warmth in the soil for setting in motion the processes of decay. Sheet composting according to the Indore Process then takes place. A few examples of sheet composting as now carried out in Great Britain will not be without interest.

One of the earliest and most effective examples of this process was originally devised by Mr. Hosier on the poor chalk pastures of Wiltshire. Following the introduction of the bail system, the undecayed organic matter in the original turf was rapidly converted into humus by means of the urine and dung of the cows. The herbage improved till about the fifth year, when no further progress was made. The turf was then ploughed up and converted into humus for the benefit of two or three straw crops followed again by a temporary ley.

On heavy grass land a dressing of basic slag is often required for starting up a similar cycle to that set in motion by Mr. Hosier's bail system on the chalk downs. I have just seen an excellent example of this on Mr. Christopher Turnor's estate at Stoke Rochford, near Grantham. I was amazed at the condition of his bullocks fed on improved grass alone.

The sheet composting of the heavy crops of chickweed on a hop garden by ploughing in the weeds with humus is being carried out with great success by Mr. L. P. Haynes at Bodiam in Sussex. Similar results are being obtained with mixed weeds on a number of fruit farms in Kent.

Perhaps the most interesting case of sheet composting is that recently adopted on some of the potato farms in South Lincs. After the pea crop is harvested in early June for canning, the land is at once sown with beans, covered with a thin layer of the crushed pea haulm from the shelling machines, followed by a thin layer of compost or farmyard manure at the rate of 5 to 7 tons per acre. The Indore Process then starts on the surface of the soil. The beans grow through the fermenting layer and by the middle or end of September are in full flower. They are then ploughed in with the finished humus. Decay is rapid and by the end of the following March the land is in excellent condition for the potato crop.

The chief opening for sheet composting in this country is in the green-manuring of old grass land by means of the turf itself. The grass is closely grazed during August and September and manured by the concentration of a large head of stock on the area to be ploughed. This is done not later than the end of September and before the soil gets too cold. After breaking up, the land is managed so that oats or a suitable grass mixture containing about 2 to 3 lb. of hardy green turnip seed to the acre can be sown in the spring. Where the bail system is in operation and the land is fertile, the fields can be broken up and re-sown in one operation, as is now the rule on Mr. Hosier's land.

The Utilization of Town Wastes. The results obtained by Sir Bernard Greenwell in Surrey and Suffolk with town wastes point very clearly to what should be done without a moment's delay in permanently increasing the fertility of the arable land of this country. A national effort should be set in motion to use the contents of the dustbin for making humus with the help of the supplies of farmyard manure and the other miscellaneous wastes available. The result will be to multiply by three the supply of farmyard manure for the arable areas round our large towns and cities. The cost of all this is within the means of the farmer provided the towns (which in any event get rid of their wastes) follow the lead of the Southwark Borough Council and prepare and sell their wastes at a reasonable figure. In this way the towns can help the farmers to improve the permanent fertility of the countryside. At the same time a valuable reserve of soil fertility can rapidly be built up which will lead to two results: (1) the local market

for manufactured articles will tend to improve; (2) a valuable war reserve in the shape of fertile soil will have been created.

The Testing of Soil Fertility. How can a farmer determine whether or not the fertility of his soil has been restored? This is an important matter, otherwise he may go on applying humus to some of his land without producing any immediate result. The great thing is to raise the fertility of the soil, field by field, till each farm produces its maximum crop. Once this is done all that is necessary is to maintain the level of fertility.

A method of testing soil fertility is clearly desirable. I am indebted to Mr. Hosier for valuable assistance in devising a simple means of doing this, which has been tried out in this country and also on the tea estates of North East India. Land can be tested for fertility by means of a complete artificial manure. If the soil is really fertile, such a dressing will give no result because no limiting factor—in the shape of shortage of nitrogen, phosphorus or potash—exists. If the soil is not fertile, a complete artificial will produce a result. On both Mr. Hosier's improved land in Wiltshire and on one of the best managed tea estates in North East India, artificial and other manures produce no result because the soil is fertile. Mr. Hosier has summed up his experience of this matter in a letter headed: Wexcombe House, Marlborough, April 6, 1938, as follows:—

"On my improved grass land, I have on several occasions put down experimental plots of artificial manures and there was no response even where there was a complete fertilizer applied Before I started open-air dairying on a big scale in 1924, I put down 150 plots and in many places I could write my name with artificials"

The value of this experience does not end with the testing of soil fertility. It suggests that a very high proportion of the fields of this island are infertile and that large volumes of humus are needed to restore their fertility.

FOOD SUPPLIES FROM A TEN-PERCH ALLOTMENT

W. H. LAWRANCE,
Ministry of Agriculture and Fisheries

With the object of demonstrating approved methods of cropping, a demonstration allotment plot was established in Cardiff by the City Council. The plot, situated at Gabalfa, is about 88 ft. above sea level. The ground faces south and is protected on the north side by a wood. The average rainfall is approximately 39.44 in.

All requisites, i.e., seeds, manures, lime, sticks, etc., are supplied by the Council, and every effort is made to keep up to date as regards the selection of suitable varieties of vegetables. The occupier carries out all the work under the supervision of the Parks Superintendent.

No record is kept of the time spent in working the allotment, and the occupier is not paid for the work; he gets the resulting crops in lieu of payment.

As the allotment is maintained for demonstration purposes, the occupier is required to be in attendance at the plot two evenings a week during the months of June and July to receive visitors and to explain the working of the allotment. A considerable number of allotment holders visit the plot during the season.

It is satisfactory to record that the general standard of cultivation of the allotments in the City has considerably improved of recent years, which may in large measure fairly be attributed to the influence of this demonstration plot.

The following brief notes give a general indication of the cropping and manuring systems adopted.

The plot is divided into three sections and the following three-year rotation is practised:—

FIRST YEAR

Section	1	Early potatoes, spring cabbage and all brassicae, peas, broad beans.
,,	2	Maincrop potatoes.
,,	3	Onions, roots, runner beans, tomatoes, dwarf beans, leeks.

SECOND YEAR ·		
Section	1	Onions, roots, runner beans, tomatoes, dwarf beans, leeks
,,	2	Early potatoes, spring cabbage, all brassicae, peas.
,,	3	Maincrop potatoes
THIRD YEAR		
Section	1	Maincrop potatoes.
,,	2	Onions, roots, runner beans, tomatoes, dwarf beans, leeks.
,,	3	Early potatoes, spring cabbage, all brassicae, peas

Approximately 3 tons of farmyard manure is dug in about December, and the soil, which is a heavy to medium loam, is left in a rough conditions to "weather." One cwt. of lime is used on the plot each year. About 70 lb. of the following mixture is used each year as top dressings when the crops require it:—

3 parts superphosphate
1 part sulphate of ammonia
1 part sulphate of potash
1 part steamed bone flour.

Records of date of sowing, quantities sown, weights and counts of crops obtained are kept.

Excluding the value of the occupier's labour, the annual amount expended on the plot on account of rent, seeds and manures is approximately £4.

Sufficient produce is grown to supply a family of four adults with ample vegetables every day all the year round, and a small surplus, which is given away. Had the occupier purchased the same amount of produce as that grown on the plot from retailers in the district, the cost would have amounted to £14 10*s*. 0*d*.

It is, of course, possible that the occupier consumed more vegetables owing to the fact that they were produced on his allotment than he would have been disposed to purchase for his family. In this there would be an advantage from the point of view of nutrition, and there is no doubt that the occupier and his family derive considerable benefit, not only financially, but also from a health point of view, in addition to the pleasure and exercise obtained by working the plot.

The following table shows the sowing and cropping returns for the season 1937:—

Food Supplies from a Ten-Perch Allotment

Crop	Sowing: Variety	Sowing: Date	Sowing: Quantity	Cropping: Date of Ripening	Cropping: Date Cleared	Harvesting Quantity	Other Notes, e.g., number, length and width of rows and drills
							All rows and drills 15 ft. long
Carrot	Intermediate	24.4.37	½ oz	August	August	25 lb	3 drills
Parsnip	Elcombes	2 4.37	½ oz	November	—	104 lb	6 drills
Beet	Crimson Globe	{2 5 37 / 22 5 37}	1 oz	August	December	115 lb	6 drills
Lettuce	Webb's Wonderful	6 4 37	¼ oz	July	August	144 heads	6 drills
Radish	Icicle	April	1 oz	June	June	—	3 drills
Broad Beans	Bunyards' Exhibition	18 2 37	½ pint	June	July	32 lb	1 treble row
Shallots	Giant	18 2 37	1 lb	July	July	14 lb	1 row
Pea	Pilot	11 3 37	¼ pt	June	June	21 lb	1 row
Pea	Gradus	27 3.37	¼ pt	July	July	19 lb	1 row
Pea	Thos. Laxton	29.3.37	¼ pt.	July	July	22 lb	1 row
Pea	Alderman	9 4.37	¼ pt.	July	July	20 lb	1 row
Cabbage	Drumhead	17.4 37	¼ oz	November	Still cutting	44 heads	8 rows
Brussels Sprouts	Sutton's Exhibition	17 4 37	¼ oz	November	Still cutting	32 lb	4 rows
Turnip	Model White	29 3 37	¼ oz	June	June	30 lb	4 rows
Swede	Garden	21 5 37	¼ oz	November	December	32 lb	2 rows
Runner Bean	Prizewinner	1 5 37	½ pt	July	September	49 lb.	1 double row
Savoy	Late Ormskirk	27.4 37	¼ oz	November	Still cutting	40 heads	6 rows
Cauliflower	Early Snowball	—	—	Crop a failure, reason unknown	—	—	—
Vegetable Marrow	Long Green	27 4 37	—	July	September	21	4 plants
Onion	Ailsa Craig	27.3 37	½ oz	August	September	105 lb	7 drills
Onion	Cranston	27 3 37	⅛ oz	August	September	112 lb	7 drills
Parsley	Moss Curled	24 4 37	¼ oz	August	Still picking	—	2 rows
Potatoes	*Sharpe's Express	1 4 37	14 lb	July	July	96 lb	8 rows
Potatoes	Majestic	10.4 37	14 lb	August	September	210 lb	6 rows
Potatoes	Ally	17 4 37	28 lb	August	September	520 lb.	13 rows
Leek	Champion	27 2 37	—	Still in ground		—	1 double row
Broccoli	Snow Winter White	19.4 37	¼ oz	Should turn in Feb.		48 heads	4 rows
Celery	Wright's Grove Red	18.3 37	—	November	December	48 sticks	1 double row
Dwarf Beans	Canadian Wonder	29.4 37	¼ pt	July	August	27 lb	1 double row
Gooseberries	—	—	—	June	July	29 lb	10 borders
Rhubarb	—	—	—	May	—	—	—
Herbs	—	—	—	—	—	—	—
Ridge Cucumber	—	29.4 37	—	August	September	24	12 plants
Tomatoes	—	31.5 37	—	August	September	60 lb.	15 plants

*These were dug prematurely owing to slight attack of Eelworm.

Food Supplies from a Ten-Perch Allotment

Crops Left on Ground for Next Season

Crop	Variety	Estimated Quantity
Kale	Green Curled	33 heads
Savoys	Late Ormskirk	32 heads
Cabbage	Drumhead	44 heads
Sprouts	Suttons	14 lb.
Cabbage	Early Favourite	72 heads
Broccoli	Snow Winter White	48 heads
Parsley	Moss Curled	—
Leeks	Champion	54
Parsnips	Elcombes	20 lb

THE YOUNG FARMERS' ASSOCIATION OF SWEDEN

SIGURD SVENSSON

The Swedish Young Farmers' Association—the J.U.F. as it is called—was founded in 1918. Its aim is to provide a non-political, all-round educational movement for farmers' sons and daughters. In all its activities the organization is primarily based on the young people's own enterprise, both in their vocational training and their general education; in other words, they are encouraged to educate themselves.

The J.U.F. works along three lines:—

(1) Social care of rural young people,
(2) their education through work;
(3) all-round, free and voluntary educational work among the adult youth of the country-side with a view to fostering technical training, good citizenship and personality.

The Association's aims set forth in its rules are as follows:—

To promote knowledge of the young farmers' home districts, especially in order to increase their love of their own country-side, its flora and fauna, records of the past, and cultural heritage,

To arouse interest in and knowledge of the agricultural industry, e g., by developing, under competent guidance, the young people's enterprise in their own economic undertakings, and by arranging competitions in crop growing, ploughing, milking, arts and crafts, and other branches of agriculture and rural economy,

To teach boys and girls thrift and how to make the best use of the income derived from their work with a view to the future;

To stimulate the interest of young people in studies and lectures, agricultural and horticultural courses, the co-operative movement, courses in arts and crafts and Red Cross work, and also in social work such as care of the aged and sick, etc.;

To arouse interest in work for the benefit of the community, such as tree planting, the protection of animals and natural objects, the preservation of fish and game, protection against fire, the beautifying of public places, etc.;

To preserve and increase the amenities of country-life by raising the standard of the home, by promoting healthy pastimes, and by giving the young people physical training and hardiness through gymnastics, games and athletics, swimming and out-door life.

The Swedish Young Farmers' Association is subdivided

into sections, usually formed within the various parishes. All sections coming within the sphere of an Agricultural Society —usually equal to a Province—are linked up in a district organization governed by a District Council. Representatives of the various district organizations meet each year at the annual meeting of the Association. Matters pertaining to the Association as a whole are dealt with by its Council in Stockholm where the Central Bureau of the Young Farmers' Association is also situated.

The junior members of the Association—boys and girls mostly of school age—devote themselves principally to what we call club activities, organized in somewhat the same way as the well-known " girls' and boys' clubs " in the U.S.A. This practical work among young people within the J.U.F. is usually under the guidance of Youth Organizers who are officers of the Association.

Boys and girls wishing to join clubs have to apply to the local club leader or direct to the Youth Organizer; they must usually be more than twelve years old. Membership of these clubs does not imply compulsory membership of a J.U.F. section, but on the other hand actual members of a J.U.F. section are obliged to take part in the practical activities which are carried out along three lines:— (1) crop growing, (2) stock raising, and (3) domestic work, the last-mentioned mainly applying to girls. Crop growing and stock raising, in which both girls and boys participate, is carried out by their own undertakings. Land is leased from parents, employers or others; seed, manure and other requisites are purchased by means of previously saved or temporarily borrowed money; space in stables or cow-sheds is hired. All work is performed by members themselves. Any draught animals required, for instance for tilling, are hired from parents or employers. Everything is done in a business-like way; all transactions must be carefully annotated, and accounts kept in books supplied for the purpose by the Youth Organizer.

Those devoting themselves to stock raising must first of all be crop growers, i.e., they must have applied themselves to the latter branch for at least a year before they may take up the former, for the reason that the growing of crops is the basis on which animal husbandry is built up. For growing vegetables the young farmers usually have at their disposal an area of not less than 100 square metres, while growers of farm crops usually have about 500 square metres. The area

is, however, adapted to the strength of the young farmer and the time he has at his disposal.

All J.U.F. farming must be exemplary. It is regarded as a trial of the best known farming methods and must be conducted conscientiously according to instructions, so that neighbours may benefit from the experience as to the suitability of various methods. The Organizer visits each boy or girl several times during the season in order to give him or her advice, check up on how the work has been carried out, and answer questions. The young farmer has gained experience, both good and bad, and now wants to know why such and such has happened. His curiosity has been aroused through experience, and this is the most important factor in all effective acquisition of knowledge. Annually some 10,000 boys and girls 12-17 years of age take part in these activities, and their number would be far greater, if only the finances of the Association permitted the employment of more Organizers. There are at present about 40 Organizers, male and female. The rule is that Organizers should not have more young farmers in their care than they can visit sufficiently often and give the guidance and advice required. It is preferable to have fewer members than ineffective instruction.

Only those who are crop growers are allowed to take part in the domestic science activities. These are conducted under the guidance of women Organizers in the form of one-day courses held alternately in the young farmers' homes. Mother is given a holiday that day. Members supply produce from their own gardens. During a course of this kind the girls—and sometimes boys—devote themselves mainly to (1) cooking, (2) baking, (3) preserving (of vegetables, fruit and berries), (4) washing-up, cleaning and other household duties, and (5) waiting at table. In addition there are courses in slaughtering and other subjects. Usually three or four one-day courses are held in one place during the summer. In this way the interest of the girls is aroused for continued studies in domestic science, for instance at one of the Rural Schools of Domestic Economy.

The great importance of the Young Farmers' movement lies in the love of the country, the love of work and the enterprise it awakens. The young people are in a rational way made acquainted with the many interesting details of farming, develop a love of animals and that " eye " for good stock which is so essential to successful animal husbandry.

The movement is also of the greatest importance for the development of agricultural economy. The male Organizer, when visiting the young farmers in his charge, has many opportunities for discussing various matters with adult farmers as well. It often happens that when a visit of this kind takes place, father also produces a list of questions. The best results, however, are obtained by the improved methods which the young people apply in their work. Their parents are in a position to observe daily the results of these methods. To impart knowledge to adults through children and young people is an old and well-tried expedient.

The same applies to the work of the women Organizers. Through the one-day courses and the new knowledge which the girls acquire, the house-wives also obtain fresh initiative. It is seldom long before they realize that they here have a rich source of information. The results are evident in beneficial practical reforms in the home, better and more health-giving food, a better utilization of good, cheap home-produced food-stuffs, improved hygienic conditions, and altogether greater comfort and happiness. The value of these courses lies in the fact that they are held in the girls' own homes, and that consequently only the resources of an ordinary farmers' household are taken into account; that they take place on several occasions during the summer when different vegetables, berries and fruit are in season; and also that the girls attend these courses over a number of years.

The male Organizer or club leader takes his boys now and then on a "field tour." Farms of fellow members are usually visited and their work inspected. Criticism is invited, and opportunity is afforded for discussing tilling and manuring, the merits of different varieties, plant diseases, etc. To mark the end of the summer season, harvest festivals and shows are arranged each autumn. Both fresh and preserved produce is exhibited, and members' account books, etc., are open for inspection.

With regard to the marketing of produce, it was originally the rule to grow produce which could mostly be used in the young farmers' own homes. This rule was gradually modified and more crops were grown that could be profitably sold, such as vegetables, sugar-beet, grass seed, etc. It was then found to be of advantage for several clubs in the same district to devote themselves to the same kind of product so that joint sales on a large scale could take place. For this

purpose agreements or growing contracts are entered into in advance with large buyers or groups of consumers. In all such matters the young farmers ask for the advice of the Youth Organizers or club leaders. In this way they realize already at an early age the value of co-operation.

Only goods of a high quality may be offered for sale. After due inspection of their produce and rational packing, the growers are entitled to affix the registered trade mark of the J.U.F. The inspection is carried out by the Youth Organizer.

The Young Farmers' Association also arranges camps to which, principally, crop growers and stock raisers who have reached a certain standard of proficiency are admitted. A pleasant week spent among friends and comrades in healthy open-air recreations is combined with practical studies and training, and visits to prominent farmers in the vicinity.

Apart from this practical work among boys and girls, the Association has taken up comprehensive practical and theoretical educational work among their senior members. Courses and competitions are arranged within practically all spheres of farming. Here, also, the initiative is taken by the young people themselves. The Council of the Association gets in touch with them through their magazine, *J.U.F.-Bladet,* which appears twice monthly (usually in 20-24 pages), and to which the young people themselves diligently contribute. In addition the Association publishes a comprehensive series of handbooks, manuals, rules for competitions, etc., all written by experts and intended partly for the young people themselves and partly for their leaders. Here are some of the titles of these publications:—*Make a Trial* (Handbook of Simple Agricultural Research); *Exploring our Native Countryside* (Handbook for Recorders of Local History and Collectors of Folk-lore); *Handbook on Judging Cattle and Pigs*; *Handbook of Horse-shoeing and Competitions Therein*; *Rambles in Forest and Countryside*; *Handbook of Cookery*; *Handbook of Bird Protection,* etc.

Manuals are also published in crop growing, poultry husbandry, calf rearing, pig keeping, rabbit breeding, quality control of produce, etc. Rules for competitions are supplied free of charge.

Competitions are held in the following subjects—milking, ploughing, root growing, vegetable growing, potato growing, flax growing, root picking, seed growing, "neatness around the home," forestry, manuring, record-keeping, hay-making

and harvesting, bird protection, preserving of garden produce, horse management, driving, carpentry, arts and crafts, athletics, sorting and packing of fruit, etc.

About 500 study circles are in existence; they conduct theoretical studies complementary to the practical work. Nowadays a farmer has to have a thorough knowledge as well as the ability and habit to keep pace with developments by reading, on his own initiative, current agricultural periodicals and literature. For the guidance of study circles, curricula have been prepared in various subjects such as potato growing, flax dressing, bee-keeping, forestry, manuring and liming, pasture management, agricultural economics, rationalization of domestic work, etc.

Members intending to devote themselves to practical work in any of the mentioned spheres, join or form their own study circle where on winter evenings they can prepare for next summer's work.

In the study circles, untrained participants start with simple subjects such as elocution, the technique of conducting meetings, spelling, mathematics, etc., before they pass on to more technical matters. Apart from agricultural subjects, there are study circles in municipal administration, co-operation, hygiene in the home, dietetics, personal and social health, the preservation of nature, Swedish geography, and also subjects such as literature. The rural young people in a comparatively sparsely populated country such as Sweden have far too long lived isolated lives. This has led to the risk of inertia, lack of enterprise and backwardness. Apart from the practical knowledge and the wider outlook acquired through work in a study circle, members learn to appreciate each other as friends and realize the vast importance of co-operation and combined efforts. These are not the least important of the tasks of a study circle.

The desire for combined effort among the members has shown itself in many concrete and valuable forms. Some 80 out of more than 600 sections have built their own premises for their activities. Members have participated in the building work in their spare time, so that it has been possible to erect the premises at a comparatively low cost. A "home" of this kind comprises as a rule a large assembly hall which can also be used as a drill hall, a smaller study, a kitchen and sometimes a few additional rooms. Occasionally a carpenters' shop and a bath-house are included, and which may also be

used by the public. Members are encouraged to work not only for their own good but also for that of the community, and in this way a healthy instinct of solidarity is fostered.

Music in which community singing takes an important part is also included in the programme of the Young Farmers' Association. In regard to musical education the study circles are valuable media. Instruction in community singing is given by experts at special courses whenever interest in the subject is evinced. The same applies to amateur theatricals. The Association works for healthy recreation in the countryside. Ancient customs at the great annual church festivals, and also in festivities in the home, are revived. Old peasant culture is studied, folk-lore is collected, special countryside records and countryside museums are established. The rural young people must not feel rootless, but realize instead that they stand on good and firm soil built up through great toil and sacrifice by their forefathers in past centuries.

As will be seen, the programme of the Swedish Young Farmers' Association is very comprehensive. It is, however, not the intention that each section should devote itself to all kinds of subjects. It should make a selection with regard to the interests of its members and the possibility of obtaining good leaders. Between the practical work of the girls' and boys' clubs and the manifold activities of our more advanced members of the J.U.F. sections there is a good co-ordination, in that the juniors at an early stage prepare for the work of the senior sections which thus receive a constant supply of good recruits.

The Association makes itself known to the outside world partly at our annual meetings or national councils, which each year are held in a different part of the country and at which members gather in their thousands, and partly at national competitions; e.g., a national competition in ploughing or milking. Within the various sections members compete for the district championships, the holders of which then gather from all parts of the country for a national competition and the selection of national champions. The procedure is thus the same as in our organized sports and athletics.

How is this work financed? The Government allow at present an annual grant of 30,000 kronor (approximately £1,700) for the central administrative work, the central bureau in Stockholm and the cost of renting of premises, salaries, etc. In addition 60,000 kronor are also granted for the salaries of

our Youth Organizers. A condition for the appointment of Youth Organizers in any one district is that the local authority, i.e., the Agricultural Society, provides a grant in a certain proportion to the Government grant. As a rule the Organizer is only engaged for the period April-October. For the remaining part of the year he or she is employed as a teacher in an Agricultural School or a Rural School of Domestic Economy. In this way first-class workers are secured at a reasonable cost.

A not inconsiderable sum is also granted annually by interested industrial concerns, bankers or private patrons.

THE PREVENTION OF ANAEMIA IN PIGS REARED INDOORS

A. S. Foot and S.Y. Thomson,

National Institute for Research in Dairying, University of Reading

Introduction. The occurrence, symptoms and causes of nutritional anaemia in suckling pigs have received a good deal of attention during the last few years. The disorder occurs in young pigs, in particular while they are confined to their mother's milk. The haemoglobin content of the blood may fall from a normal of 8 or 9 grm. per 100 ml. of blood at birth to as low as 2 or 3 grm. per 100 ml. at three weeks old. This results in a noticeable paleness of nose and ears. The young pig may be fat, flabby and lethargic at first, but may become "runted" and emaciated later. The condition causes many losses, not only directly, but also due to the fact that it is often associated with scouring and other ailments.

In normal farm practice the administration of iron salts will prevent or cure the anaemic condition.

Probably both iron and copper are essential, but in most of the practical studies there has been sufficient copper present as an impurity in the iron salt used, or the young pigs have had a sufficient reserve of copper, to make the addition of copper salts unnecessary. When young pigs commence to take solid food, the anaemic condition is gradually relieved owing presumably to the iron content of normal meal mixtures. As might be expected, the disorder is much less common in pigs raised out of doors, since they "root" and obtain iron from the soil or vegetation.

Attempts to raise the iron content of milk by the administration of iron to the sow have been unsuccessful. For example, comprehensive studies[1]* by Hart *et al.*, showed that the feeding of additional iron in the form of ferric sulphate (with or without copper as copper sulphate) to gilts during their growing and pregnancy periods had no effect on the incidence of anaemia in the ensuing litters. Other studies have tended to confirm these results, but the amount of iron salts fed to pregnant sows in such experiments has generally been fairly low.

* For references see p. 459.

It appears, therefore, that pigs during the first few weeks of life require iron in addition to their mother's milk, and the practical issue is chiefly concerned with the best means of supplying the iron.

Objects of Investigation. In December, 1937, the writers were faced with the problem of raising twenty litters indoors during the winter months, and with the above knowledge at their disposal the prevention of anaemia appeared at first sight to be a fairly simple matter. There were, however, certain practical points that merited further study.

(1) It appeared to be uncertain whether the iron salts that had previously been used were in fact the best material available. For example, Baskett and Lamont[3] stated that iron sulphate solution led to constipation unless great care was taken to graduate the dose. Again, some of the iron salts are astringent and consequently distasteful to young pigs. In this connexion, it seemed worth while to try iron pyrophosphate, a salt that has been recommended by Elvehjem *et al.*,[4] and which is not astringent.

(2) The writers were not convinced that it had been completely proved that the administration of large doses of iron in late pregnancy is ineffective in preventing anaemia in the ensuing litter. It was, therefore, decided to try feeding higher doses of iron to the sow for a short period immediately before farrowing.

(3) As the sample of iron pyrophosphate to be used contained only 20 parts per million of copper it was decided to try once more the effect of added copper on the concentration of haemoglobin during the critical second and third weeks.

(4) It seemed that the time of dosing of young suckling pigs against anaemia was a subject for further investigation.

Experimental. REARING OF LITTERS. Observations were made on twenty litters, all of which were raised under similar conditions. The experimental data are mainly concerned with the first three weeks of life of each litter, during which period the piglings received no other food beside their mother's milk and the iron or copper supplements discussed below. They were entirely confined to the piggery during this period. At three weeks old, each litter was placed in a fold unit in the open and had access to a run paved with cinders. At this stage also they were offered a meal mixture behind creeps.

All the sows were pure-bred Large White, except one, which was a Large White × Middle White cross. All were mated to one of three Large White boars.

TREATMENT OF PREGNANT SOWS. Eight sows received during the last fortnight of pregnancy iron pyrophosphate in their food. The total amount fed to each sow ranged from 100 to 560 grm., that is, approximately 12.5-70 grm. of iron per sow. Eight control sows, receiving no iron, were selected individually and paired with the experimental sows. All sixteen sows were confined to the piggery during the last fortnight of pregnancy and during the first three weeks of suckling.

TREATMENT OF THE SUCKLING PIGS. The supplements administered to the young pigs are recorded in Table 1. The iron was given in the form of iron pyrophosphate solution and the copper as copper sulphate solution. The period of dosing was one of six days either during the second or during the third weeks of life.

The solutions were made up so that a dose consisted of 2 ml. of liquid. This was administered by mouth with a glass pipette protected with rubber tubing.

HAEMOGLOBIN ESTIMATIONS. Every individual pig in each litter was examined for the concentration of haemoglobin in the blood at the end of the first, second, third and fourth week of life. In addition, six of the litters were tested about twelve hours after birth, and at four days old. A few were also investigated at more than four weeks old.

Samples of blood were taken from the ear and the acid haematin method, using the Newcomer glass standard, was adopted for estimating the haemoglobin concentration.

Results. (1) THE USE OF IRON PYROPHOSPHATE. During the course of these experiments no disadvantages in the use of iron pyrophosphate were manifest. The fact that it is not astringent allows the dose to be concentrated to 0.03 grm. of iron in 2 ml. solution, which was found to be a convenient quantity to administer to young pigs.

Although certain pigs developed mild scouring, especially in the litters from one family of sows, no connexion between this and the use of iron pyrophosphate was traceable.

(2) THE ADMINISTRATION OF IRON TO PREGNANT SOWS. The effect of adding iron to the diet of the sow during the last two weeks of pregnancy may be measured by the haemoglobin

TABLE I.—DOSAGE OF SUCKLING PIGS

No. of Litters	Time of Treatment	Supplements Administered (per pig)
1	—	None.
1	3rd week	0·002 grm. copper daily for 6 days
5	3rd ,,	0·030 ,, iron daily for 6 days.
5	3rd ,,	0·030 ,, iron + 0·002 grm copper daily for 6 days.
4	2nd ,,	0·030 ,, iron daily for 6 days
4	2nd ,,	0·030 ,, iron + ·0002 grm copper daily for 6 days

TABLE II—EFFECT OF FEEDING IRON TO SOWS IN LATE PREGANANCY ON THE HÆMOGLOBIN CONCENTRATION OF THE BLOOD OF THE ENSUING LITTERS

	Total Iron Fed (grm.)	Average Hæmoglobin Concentration in Blood of Litters (grm per 100 ml)			
		From Sows Receiving Iron		From Sows not Receving Iron	
		1 week old	2 weeks old	1 week old	2 weeks old
Pair 1 .	12·5	6 00	3·33	5·53	3·60
Pair 2 ..	30·0	5·52	3·58	4·94	2·84
Pair 3 ..	32·5	6·33	—	6·85	—
Pair 4 ..	35·0	5·38	3·68	5·97	3·62
Pair 5 ..	35·0	5·71	—	4·80	—
Pair 6 ..	45·0	5·30	3·11	4·36	3·10
Pair 7 ..	70·0	5·78	—	4·89	—
Pair 8 ..	70·0	5·03	—	5·22	—
Average of all litters ..	—	5·63	3·42	5·32	3·29

content of the blood of the pigs in the ensuing litters. Table II gives the average concentration in the blood of pigs in eight litters where the dam had received iron, and in eight comparable litters where no iron had been fed. It is seen from the average figures of the 16 litters at one week old and for eight of these at two weeks old, that there was no practical difference in the degree of anaemia in the pigs in the two groups. This observation applies even where such a high total dose as 70 grm. of iron (560 grm. of iron pyrophosphate) was fed to sows during the last two weeks of pregnancy.

(3) THE EFFECT OF ADMINISTERING COPPER IN ADDITION TO IRON TO SUCKLING PIGS. The effect of dosing anaemic pigs with any particular supplement may be measured by the difference in the concentration of haemoglobin in the blood before and after dosing. In comparing iron treatment with iron

TABLE III.—EFFECT ON HÆMOGLOBIN CONCENTRATION OF DAILY DOSAGE OF IRON AND IRON PLUS COPPER DURING SECOND OR DURING THIRD WEEK

Treatment of Litter	Time of Dosage	No of Litters Treated	Total No of Pigs Treated	Average Hæmoglobin (grm per 100 ml blood)		
				Before Dosing	After Dosing	Gain or Loss
				2 weeks old	*3 weeks old*	
Not dosed	—	1	12	3·34	2·49	− 0·85
Copper only	3rd week	1	12	4·22	3·41	− 0·81
Iron only	,,	5	33	3·42	7·39	+ 3·97
Iron and Copper	,,	5	42	3·25	7·21	+ 3·96
				1 week old	*2 weeks old*	
Not dosed	—	1	12	5·03	3·34	− 1·69
Iron only	2nd week	4	37	5·74	8·08	+ 2·34
Iron and copper	,,	4	39	5·50	7 71	+ 2·21

TABLE IV—EFFECT ON NUMBER OF LOSSES AND LIVE WEIGHT OF DAILY DOSAGE OF IRON AND IRON AND COPPER DURING SECOND AND DURING THIRD WEEK

Treatment of Litter	Time of Dosage	No of Litters Treated	No Born	No Alive at 2 Weeks	No Alive at 8 Weeks	Losses 2 to 8 Weeks	Average Weight at 3 Weeks (lb)	Average Weight at 8 Weeks (lb)
Not dosed	—	1	11	11	8	3 died anæmia	8·5	17·8
Copper only	3rd week	1	16	12	7	5 died anæmia	7·3	25·2
Iron only	,,	5	61	33	33	—	10·4	28·8
Iron and copper ..	,,	5	70	42	40	1 scoured, 1 starved	9·7	27·3
Iron only	2nd week	4	64	37	35	2 starved	11·0	34·0
Iron and copper ..	,,	4	51	39	38	1 runt killed.	11·2	35·7

and copper treatment, the data for the concentration of haemoglobin immediately before and immediately following six days of dosing have been summarized and set out in Table IV, and comparable data for one litter that was not dosed and for one litter that received the six doses of copper only have been included.

Figure 1 shows curves of the haemoglobin concentration of typical litters on the various treatments. The continuation of decline in the haemoglobin curve, where a litter was not dosed, and the complete lack of response where copper only was administered, is shown clearly. On the other hand, the pronounced response to iron or iron and copper treatment is notable. From the data in Table III it seems clear that under the experimental conditions the copper additions, even in conjunction with iron, had no demonstrable effect.

(4) EFFECT OF TIME OF DOSING. Many investigators have shown that the pig is born with a satisfactory haemoglobin content (about 8-9 grm. per 100 ml. blood). This concentration normally falls rapidly during the first three or four days of life, and this appears to be so even when the little pig receives an adequate supply of iron and copper. When the pig commences to take solid food at four weeks of age, its need for these elements becomes satisfied. There is, however, little information available to show the best period within this age interval of 4 to 28 days, where iron and copper treatment would give the most beneficial result in practice. The comparison between the haemoglobin results of those pigs dosed during the second week and those dosed during the third week, as shown in Table III, is, therefore, of particular interest. It is clear that, whereas the dosing carried out during the second week of life acted as a preventive of advanced anaemia, dosing during the third week cured pigs already suffering from the disorder.

Table IV shows that the eight litters dosed during the second week were substantially heavier at weaning than those dosed during the third week. The latter were rather subnormal in this respect, but there were no casualties in this group that could be attributed directly to anaemia, as were found in the litter that was not dosed or in the litter that received only copper.

Discussion. The extent of anaemia on pig farms in this country is not accurately known, but is probably fairly general

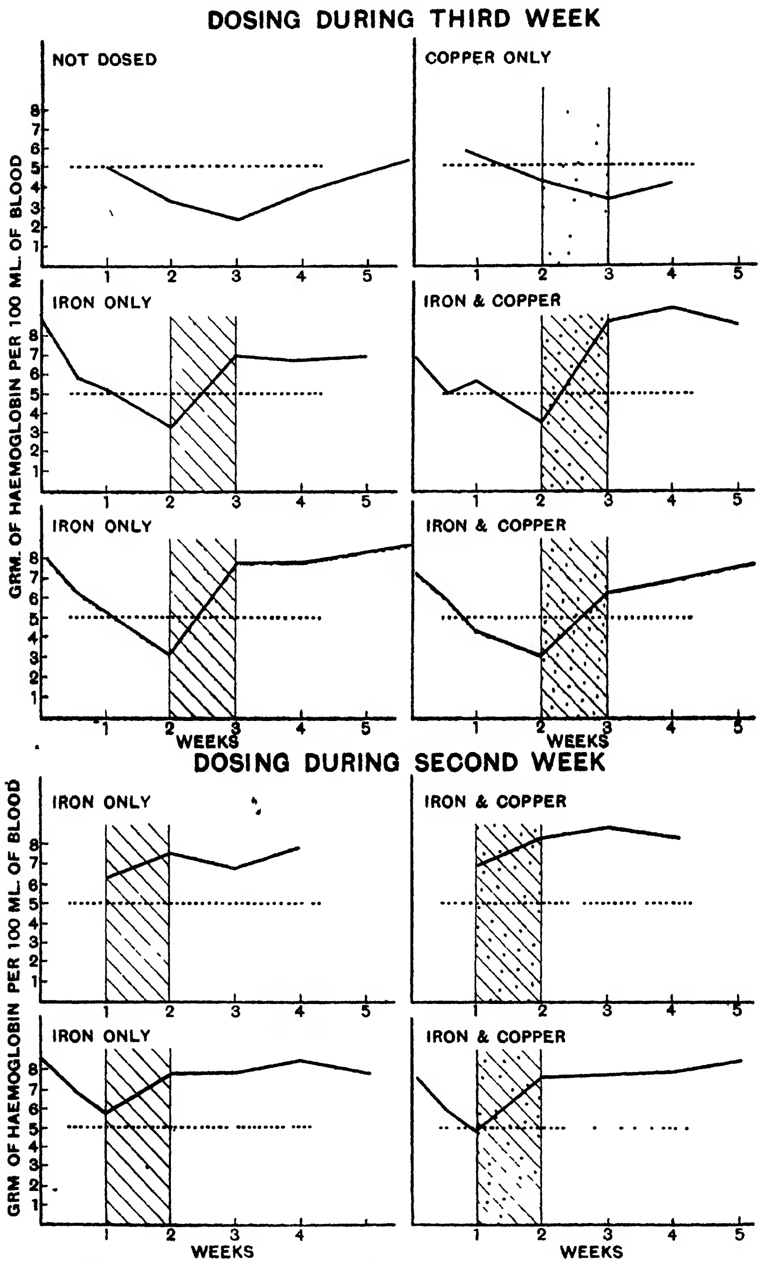
DOSING DURING THIRD WEEK
NOT DOSED
COPPER ONLY
IRON ONLY
IRON & COPPER
IRON ONLY
IRON & COPPER
GRM. OF HAEMOGLOBIN PER 100 ML. OF BLOOD
WEEKS
WEEKS
DOSING DURING SECOND WEEK
IRON ONLY
IRON & COPPER
IRON ONLY
IRON & COPPER
GRM OF HAEMOGLOBIN PER 100 ML. OF BLOOD
WEEKS
WEEKS

FIG. 1

in pigs confined to sties. The conditions may be easily relieved by iron treatment. It should, however, be realized that if anaemia, or associated ailments, cause the young pig to become stunted and emaciated no amount of dosing with iron salts will bring a rapid improvement. In preventing the condition early treatment is therefore essential. The results of this experimental work here reviewed show clearly the advantage of treatment during the second week of life over treatment during the third week. One reason why outdoor rearing of litters is becoming popular would seem to be that anaemia is prevented at an early stage and by natural means. If the pig is to be completely protected it must be given access to the iron of the soil or to iron in some other form during the second week of life. When little pigs commence to take solid food, the condition, as a rule, is gradually relieved, but these experiments show that if pigs are kept on a concrete floor during the time that their diet consists solely of milk, a condition of anaemia almost invariably appears.

The inability of the sow to pass on to the little pigs iron added to her diet now seems to be well established. The pig-farmer has therefore to give attention to the direct supply of iron to the youngsters. One practical remedy is outdoor rearing or running the litters out during the critical second and third week. Failing this, he may place soil in the sty, rub iron preparations along the sows' teats or dose with iron solutions. If the last method is adopted, iron pyrophosphate appears to have certain advantages over some of the other iron salts or preparations.

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THE TOMATO LEAF MINER AND ITS CONTROL

MORRIS COHEN, M.Sc., Ph.D.,
Department of Zoology (Agricultural Entomology),
The University, Manchester

In recent years the Tomato Leaf Miner (*Liriomyza solani* Macq.), has been recorded as causing some injury to tomatoes in the British Isles. In England, the first occurrence of this insect was in Middlesex in 1926.[3]* In 1935 and 1936 the leaf miner was again present in this area and also at Cheshunt.[1] In Jersey the insect was first noted in January, 1934, and again caused severe damage in December, 1936, and in 1937 to pot plants and to plants that had been set out in the houses.

On the Continent the insect has been recorded from north France and Central Europe.[3]

The following account summarizes the results of observations made during 1937.

Description and Life History. *Liriomyza solani* Macq. is about one-twelfth of an inch long and is distinguished from the Chrysanthemum Leaf Miner by the thorax being shining black and the abdomen coloured yellow on the under surface (Fig. 1).

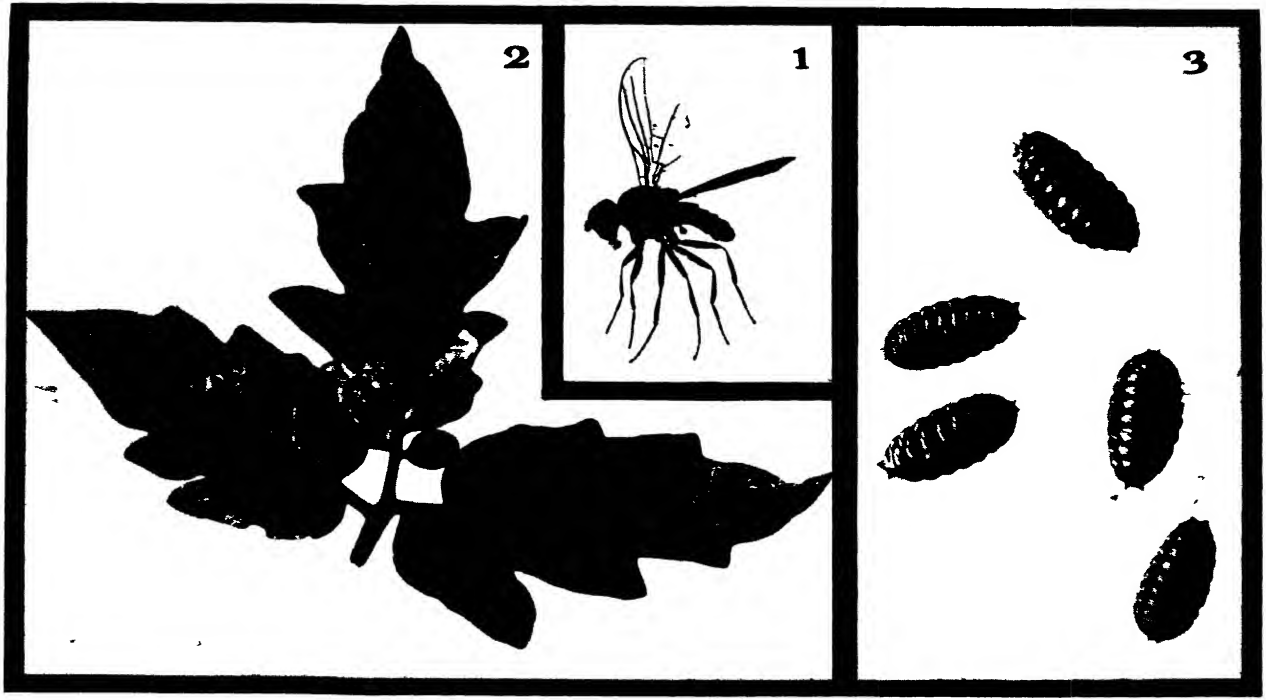
The flies may be found about the undersides of the leaves of seedling and established plants, and are not very active, taking only short, jerky flights. Like the Chrysanthemum Leaf Miner, the females pierce the leaf tissue with the ovipositor and feed on the sap that exudes from the puncture. The males are unable to pierce the leaves.

The eggs are narrowly elliptical and are inserted deeply into the undersides of the leaves. Usually only 2-3 eggs are laid in a leaf, but this number is increased in heavy infestations.

After hatching, the minute legless maggots tunnel into the leaf issue and make their way towards the upper surface. Within the mine the larva rasps away the green tissue with its mouth hooks. The mines, at first narrow, become broader and tortuous, the maggots moulting twice and reaching maturity after about 10 days.

When fully fed the larvae are about one-seventh of an inch long. They are legless, semi-transparent maggots; the front

* For references, see p. 462.



TOMATO LEAF MINER

1.—Adult (× 10)   2.—Tomato Leaf showing punctures made by adult flies and mines made by the Leaf Miner.   3.—Puparia (× 10)

third of the body is of bright orange colour and there is a small, almost black ring at the extreme hind end of the body. These two features distinguish the larvae from those of the Chrysanthemum Leaf Miner.

The mines usually follow the mid-rib of the leaf for a part of their course, but end on the blade of the leaf, where the mature larvae cuts an irregular curved slit through the upper epidermis. The maggot, now on the surface of the leaf, forms a pupa within the larval skin, which shrinks and hardens to form a puparium (Fig. 3) about one-eleventh of an inch long. The puparia adhere only lightly to the leaf-surface and are easily blown or shaken off and drop to the ground.

The pupal period is variable and lasts from 35 to 42 days at 60°F. When the fly is ready to emerge the puparium splits at the anterior end and the fly forces its way out.

The average period from the laying of the egg to the emergence of the adult is about 52 days, and several generations are produced during the year.

Plants Attacked and Nature of Damage. In addition to the tomato plant, Seguy[2] records that potatoes, Bittersweet (*Solanum dulcamara* L), Black Nightshade (*Solanum nigrum* L), and the Tea tree (*Lycium chinense* Mill), are host plants for *Liriomyza*. None of these alternate plants has been recorded as hosts in this country, and so far as is known the fly does not attack plants of families other than the *Solanaceae*.

The injury caused by the larvae, which live between the upper and lower surfaces of the leaves, consists of winding tunnels which broaden as the larvae grow (Fig. 2). Two or more larvae may be present in a leaf and may often destroy the whole of the green tissue. A very minor type of injury is associated with the feeding punctures made by the female flies. After piercing the tissue with the ovipositor the flies suck up the sap that exudes from the punctures, and the tiny bleached areas afterwards become calloused.

The injury does not appear to have been noted in the seedling stage, but severe attacks have been observed on young plants in 4-in. pots and on plants shortly after setting out in the glasshouse. There appears to be a peak infestation during July and August when the older leaves are attacked.

Control Measures. The Tomato Leaf Miner is subject to attack by a parasite belonging to the family *Braconidae*

(*Hymenoptera*). These parasites are minute ichneumon wasps which feed and develop within the bodies of the fly maggots. In material obtained from Jersey in 1937, from 35 to 40 per cent. of the puparia were parasitized as early in the year as April, and Speyer,[3] too, noted a heavy degree of parasitism in August in an outbreak in Middlesex.

As with the Chrysanthemum Leaf Miner,[1] the parasites have some effect in reducing the number of flies in the subsequent generation but, since they allow the maggots to complete their development, no reduction is effected in the amount of injury to the foliage at the time of parasitism. In view of this, artificial control measures must be used.

Recommendations. Fumigation with hydrocyanic acid gas or with nicotine will destroy the flies. The larvae may be destroyed by the use of a soap and nicotine spray consisting of ¾ oz. of nicotine (98 per cent. purity) and ½-1 lb. of soft soap in 10 gal. of water. Flies, eggs and larvae are killed, but puparia are unaffected. The spray should therefore be applied at intervals of 15-20 days. The spray should cover both surfaces of the leaves. Weeds of the family *Solanaceae* should be rigorously kept down.

The writer is indebted to Dr. T. Small, Mycologist to the States of Jersey Experimental Station, for his kindness and interest in supplying material and information as to the occurrence of the infestation in the island of Jersey.

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AUGUST ON THE FARM

R. W. Wheldon, D.Sc.,
King's College, Newcastle-upon-Tyne

Weather conditions have favoured root crops in most districts during the past month, and although the amount of rain that has fallen is below the average for the time of year, it has been enough to produce growth of grass and to maintain its colour. Dull, showery weather, although it may promote growth, is not the best for hay-making, which most farmers have found rather difficult. In the north of England and in Scotland the general method of hay-making is to " pike " hay in the field and leave it for a period before carting to the stack. In poor weather this practice has much to recommend it, as the hay can safely be put into pike, built in the same way as a large " cock " weighing 6-10 cwt., before it can be stacked. This reduces the risk of spoiling, as a well-made pike will take little harm during bad weather. In spite of the fact that the weather at hay-making time is more hazardous in the north than in the south, north-country hay compares very favourably with that made in the south as regards condition, and is frequently of better feeding value since the plants are more leafy. In dry, warm weather there is always a tendency for plants to send up flowering stems, while cool, moist weather favours vegetative growth and the production of a large proportion of succulent leaf to less nutritive stem.

Harvesting. August is a strenuous month on corn-growing farms and long hours are worked by horse and man.

Barley. Every operation in the management of this crop —cultivation, seed, manuring, harvesting and threshing—have as their object a uniform sample of fully-matured grain, but in many places this ideal will prove difficult to realize this year. Owing to the early dry weather the seed germinated at different times, and some plants are now showing signs of maturity while others are still green. If calm weather maintains the crop can be left until all the plants are sufficiently matured, but with some varieties there is a measure of risk as mature heads may be broken off by the wind, resulting in considerable loss. In spite of this, however, the hope of a

good price for a good malting sample will be sufficient inducement to most growers to take the risk.

Oats can be cut with advantage before the crop has reached the same maturity as is required for barley. If cut when the straw is still a little green, good feeding straw for stock can be obtained without loss to the grain. In the present year, when hay is short, every effort should be made to obtain oat straw of good feeding value. If cut too early, however, the stooks must stand longer in the field, with the associated risks.

Wheat affords less anxiety than other cereals. Provided the variety produces a clean chaff, wheat can come through a good deal of bad weather without serious harm, provided attention is given to the stooks. Varieties with a hairy chaff tend to hold moisture, and there is a great risk of these wheats sprouting in the stook during wet weather. It is understandable why wheat is held in such favour with the cereal grower as a crop, apart from the question of return obtained. It is, perhaps, less insistent on a fine seedbed than barley, or it may be more correct to say that a suitable seed bed is more readily obtained; it can be sown over a longer period, practically from September to April; it is not so liable to lodge as other cereals, and harvesting risks are less.

It is now time to consider the choice of varieties for autumn sowing—a most important matter that makes all the difference between a profitable and an unprofitable crop. It is only by comparison under similar conditions that the respective merits of different varieties can be assessed. A certain variety may yield quite a good crop and the farmer be satisfied with the result, but another variety may be more suitable to his conditions and give an even better crop, and the best should be aimed at. In most counties variety trials are carried out, yielding much useful information, and the County Agricultural Staffs can give much help on this question.

This year there is little sign of lodging in any variety as straw is generally short. If crops are found to be liable to lodge on land in good heart this question should be particularly considered when choosing varieties. The present season is abnormal and the behaviour of any variety under such conditions cannot be taken as a standard.

Live Stock. Markets for fat cattle and sheep still give little encouragement to the feeder. Only cattle that have done

well at grass are likely to leave any margin for feeding, and sheep in most instances have lost money. Store cattle are cheaper, as might be expected, but not exceptionally so. No market reports for store lambs are to hand at the time of writing, but fat lamb prices do not favour a good market.

In spite of present conditions, however, the business of farming must go on, and where early fat lambs are desired the rams will be turned away to the ewes. Successful fat lamb production requires, first, a lamb with aptitude to put on flesh, secondly, a good supply of milk, and thirdly, ability to consume and make good use of trough food at an early age. Choice of both ram and ewe are important considerations at the present time. So far as the ram is concerned, early maturity and good fleshing qualities are important, while with the ewe, good milking properties are required in addition. Sun, warmth and fresh grass do something to make up for poor milking properties in the ewe in spring, but these are lacking when required by the lamb for the early market. In addition to pastures, aftermaths are now available for grazing stock. The clean ground is especially welcomed by sheep farmers, but all classes of stock appreciate a change. Reference to the falling off in the value of pasturage at this season of the year was made in the July Notes, and it is most important that stock should not be allowed to slip back. More especially is this so with dairy stock, and supplementary food should be fed if there is any sign of falling off in yield.

Milk Records. It is disappointing that only a small percentage of dairy farmers keep milk records, and although some keep unofficial records the total amount of recording is regrettably low. The advantages of recording to the breeder and milk producer have so frequently been stated that repetition would seem unnecessary. Labour and cost are usually the chief objections raised against the system, but these are both more than repaid by the application of the information obtained. It is true that the breeder stands to gain most, but recording is essential to economic milk production, even on farms where breeding is not important. It is desirable that a start be made at the commencement of the official year—October 1—and dairy farmers are advised to give the matter very careful consideration.

Potatoes. The crop shows much improvement since the rain, although second growth is found in some varieties. It

is too early to forecast what the crop may be. It is not too early to think of the 1939 crop. If a considerable acreage is grown, and seed has been obtained from different sources, it will almost certainly be found that some stocks are better than others of the same variety. Health and origin of stock are most important considerations in crop production. Any stocks from which seed is to be saved for next season's growing should be carefully examined for disease, such as Leaf Roll and Mosaic. If signs of these are widely found, no seed should be saved from the crop, while if only a few plants are affected very careful rogueing should be done. Should a grower not be able to identify these diseases, he should seek the assistance of the Adviser in Mycology at the Provincial Centre or a member of the County Agricultural Staff. It is a matter of sufficient importance to warrant the attention of all growers, and it is probable that no single consideration in the growing of the potato crop promises a greater return if attended to.

Pastures generally have been very closely grazed this season owing to the dry weather. Even rough matted pastures are better grazed than they have been for years and are in good condition for the application of fertilizers where improvement is contemplated. A rough mat makes it most difficult for plants such as Wild White Clover, which are naturally associated with grassland improvement, to become established. Improvement of poor grass is invariably combined with a change in the character of the herbage, the poorer species giving place to those of greater productivity and feeding value. Good soil conditions and the absence of severe competition from inferior plants are as necessary as manuring. In many places the present season offers a favourable opportunity to start the improvement of poor pasture land, as surface conditions are better than for some years.

On some of the best managed and most productive pastures, the spreading of the droppings of the grazing stock is a normal part of the management, and pastures benefit greatly from this. The short condition of the pastures show up the droppings this season and spreading is very easily done when the pasture is short. Where labour is available this operation is well repaid.

On dairy farms there is a great loss of lime and phosphates from the soil and systematic applications are

desirable to ensure an adequate content of these materials in the pasturage produced, a consideration of great importance to the milking cow.

Education. The education of the farmer occupies a lifetime. He learns by observation on his own farm and from what he sees on other farms. During the last 40 years much has been done by Government assistance to acquire and make available to the farmer, knowledge of the business of crop production, livestock breeding and management. Research stations have been established to deal with special problems, and county authorities have provided farms for demonstration purposes. Visitors are welcomed to these stations, and although many farmers pay regular visits the available facilities are, on the whole, inadequately used. There is always much to be learned at these centres and the effort required to make such a visit is invariably amply repaid. The summer months usually provide the most favourable aspects of the experiments in progress, and early August affords an opportunity of seeing most crops at an interesting stage of growth.

NOTES ON FEEDING

CHARLES CROWTHER, M.A., Ph.D.,
Harper Adams Agricultural College

Sprouted Grain as Succulent Feed. The belief that grain acquires special nutritive virtues in the process of germination is of very old standing amongst stock-feeders. As far back as 1865 Lawes thought it worth while to make comparative tests of barley and malt with milch cows and sheep, and in the following year Johnson published the results of similar comparisons made with pigs. These experiments, in which the malt and the accompanying by-products (malt coombs) were fed in the usual kiln-dried form, indicated that a given weight of barley is worth more as food than the amount of malt and malt coombs that can be made from it. Subsequently, interest in the question has flared up periodically, but such further experiments as have been carried out on the same lines have only tended to confirm the earlier observations.

Some loss of nutritive matters in the conversion of grain into malt is inevitable, and generally amounts to 5-7 per cent. of the dry matter, partly removed in the steep water and partly by oxidation of nutrients during the germinating process. This loss can only be made good after green leaves have been formed, and then only if the rootlets are in contact with a nutrient medium.

Clearly, therefore, the germinated grain can only have a nutrient value equal to, or higher than, that of the ungerminated seed if in the process of germination ingredients are produced which, when introduced into the animal, bring about by stimulation, or otherwise, an increased efficiency of utilization of the nutrients. This might possibly be associated with an improvement of palatability, or an increase of digestibility. Claims based upon an assumption of these properties have indeed been persistently advanced both for malt and for malt coombs, but, as indicated above, with as yet but slender support from experiment. That kiln-dried malt and malt coombs possess for the healthy animal any special virtue not assessable in terms of " starch equivalent " must therefore be regarded as improbable.

This does not exclude, however, the possibility that the fresh undried germinated seed, complete with shoot and rootlet, may possess such virtues, which may be destroyed

in the kiln-drying process. Evidence is now available, indeed, from recent feeding experiments with cattle and sheep, that establishes at least a *prima facie* case for such differentiation between the fresh and the dried product.

These experiments, which have been made with maize sprouted under carefully regulated conditions, have been carried out during the past three years at the Auchincruive farm of the West of Scotland Agricultural College, and a summary of the results obtained is now available in a report by Principal Paterson in the current volume of the *Transactions of the Highland and Agricultural Society of Scotland* (5th Series, Vol. 50, pp. 38-67). (The report has also been published separately as *Bulletin No.* 133 by the College.)

In these experiments the maize was sprouted for 10 days in a special germination cabinet housed in a heated building, whereby the temperature could be kept within the extreme limits of 70-90°F, or more generally 75-85°F. During the germination the maize was kept in contact with water to which a plant nutrient preparation of undisclosed nature had been added. Full details of the plant used and of the working of the process are given in the report and it will suffice to indicate here that the weight of succulent food (rootlets included) obtained by the tenth day was from 3½ to 4 times that of the original grain. Typical samples of the product contained about 22 per cent. of dry matter, or about one-quarter of the concentration of the original dry maize. The loss of dry substance of the original maize was apparently about 7 per cent.

Six feeding trials were carried out with fattening cattle, in which the effects of replacing 10-30 lb. of swedes in the rations by weights of the sprouted material supplying the same amount of dry matter (9 lb. "sprout" = 20 lb. of swedes) were determined. The full allowance of swedes being 60 lb. per day, the various degrees of replacement thus ranged from one-sixth to one-half of this allowance. Out of a total of 168 cattle used in the experiments, which included also tests of dried grass, 70 received "sprouts" as part of their ration. The average initial live weight in the different experiments ranged from about 7-9 cwt. and final live weight 9-11 cwt., the feeding period being 12 or 14 weeks.

The cattle, all bullocks, used in the experiments were purchased in early October each year, the heavier and more forward bullocks being housed at once in the feeding house

Year	Experiment	Group	No in Group	Weight Swedes Replaced	Av L W Gain per Week	Av L W Gain Control = 100
				lb	lb	
1935–36	A (12 weeks)	Control	12	—	18·0	100
		"Sprout"	4	20	21·8	121
	B (14 weeks)	Control	12	—	16·6	100
		"Sprout"	4	20	20·7	124
1936–37	C (12 weeks)	Control	10	—	15·6	100
		"Sprout"	10	20	17·2	110
		"Sprout"	8	30	16·8	108
	D (14 weeks)	Control	8	—	15·0	100
		"Sprout"	4	20	19·7	132
		Dried Grass*	8	—	13·1	88
		Dried Grass* with "Sprout"	8	20	16·3	109
1937–38	E (12 weeks)	Control	6	—	14·6	100
		"Sprout"	6	20	18·1	124
		Dr Grass (high grade)*	6	—	15·35	105
		Dr Grass (med. grade)*	6	—	14·2	97
		Dr Grass (med. grade)* with "Sprout"	4	20	17·5	120
	F (12 weeks)	Control	6	—	15·75	100
		"Sprout"	8	10	19·65	125
		"Sprout"	6	20	19·4	123
		"Sprout"	8	30	18·2	116

* Concentrates completely replaced by equal weight of dried grass

and used for the first experiment of the season, whilst the rest were run outside until January when they were brought in and used for the second experiment.

For details of the nature of each experiment and the observations made thereon, reference must be made to the original report, but the appended summary will suffice to indicate the consistency of the testimony as to the merits of the sprouted material under the conditions of the experiments.

Experiments A, C and E were carried out in the months October to January, and Experiments B, D, and F in January to April. For the sake of completeness, the results obtained from groups that received dried grass have been included in the table, but these will be commented upon separately in a later section.

Points of special interest in the table that may be noted are:—

(*a*) In every instance, without exception, the group receiving "sprout" showed a higher average growth-rate than the corresponding control group Apart from Exp C in which the sprouted material was not of the usual quality the growth rates on the "sprout" rations were 20–30 per cent. higher than on the control rations

(*b*) There was no advantage in increasing the allowance of "sprout" beyond that corresponding to 20 lb. swedes (Exps. C and F), or possibly even beyond one-half of this amount (Exp. F).

(*c*) The results obtained in Exps. D and E suggest that the sprouted grain supplies some factor of value in animal nutrition that is not supplied to the same extent by dried grass.

One way in which sprouted grain might raise the nutritive value of rations to which it is added would be by stimulating the digestive processes and thereby raising the digestibility of the whole ration. To test this possibility a digestion trial was carried out with two bullocks, using a ration very similar to the standard ration used in the feeding trials, except that mangolds were used in place of swedes. Some improvement of digestibility by the inclusion of "sprout" was found, especially with regard to the true protein, the digestion co-efficient of which was raised from 53.4 per cent. to 59.1 per cent. The changes were too small, however, to furnish more than a partial explanation of the results of the feeding experiments. An account of the digestion trial is given in a paper by McCandlish and Struthers published in the April, 1938, issue (Vol. XXI, No. 2) of the *Scottish Journal of Agriculture,* in which will be found also data on the changes in the constitution of the dry matter of the maize during the sprouting process and the gains or losses of individual ingre-

dients occasioned thereby. Mineral matter and " amides " increased in quantity, probably through absorption from the nutrient solution in which the grain was immersed. Fibre also increased through the conversion of starch of the grain into cellulose in the growing plantlet. The amounts of carbohydrate and oils decreased.

In addition to the quantitative records of the feeding experiments summarized above, observations were also made upon the quality of the beef produced on the various rations. Here again the evidence was entirely favourable to the sprouted grain feeding. " It produces meat of excellent appearance, singularly tender, and attractive to the palate." Its superiority over the meat from the control groups was always very pronounced. It is remarked further that " sprout "-fed cattle in winter always showed a material improvement in bloom within the first 3 or 4 weeks and assumed the general appearance of grass-fed animals. There was never any marked difference in carcass percentage, however, between the two sets of animals.

These Scottish experiments have certainly furnished ample justification for further investigation of the nutritive properties of sprouted grain, and if the possession of special nutritive properties be confirmed by further feeding tests an attractive field of investigation will be opened up to the research worker in isolating and identifying the causative factor or factors underlying the specific effects.

Dried Grass for Fattening Cattle and Sheep. As indicated in the Table above, dried grass was tested in two of the Scottish cattle-feeding experiments (D, E). In these experiments the whole of the allowance (6-8½ lb. per head daily) of concentrated food in the control rations was replaced for the experimental group by an equal weight of dried grass.

In Exp. D, in which a dried grass of medium quality (crude protein, 11.2 per cent., fibre, 20.3 per cent.) was used, the average growth rate of the 8 cattle was about 12 per cent. below that of the control group, this inferiority being converted into a superiority of 9 per cent. when " sprout " was used along with the dried grass.

In Exp. E two grades of dried grass were compared, the " high grade " containing 16.3 per cent. crude protein and 17.6 per cent. fibre, and the " medium grade " 11.3 per cent.

crude protein and 19.0 per cent. fibre. In this instance, whereas again the " medium grade " product proved barely equal to the concentrates, the " high grade " product proved fully equal, if not superior, to the latter. Once more also the use of " sprout " along with the dried grass improved the growth rate. The results warrant the general conclusion that dried grass may be used in feeding beef cattle as a substitute for the greater part, if not the whole, of the usual allowance of concentrated foods, provided that it is at least of " medium " grade.

Two further experiments were carried out to test the possibilities of dried grass in the fattening of sheep. In the first of these (1936-37) four groups of 32 hoggets (Border Leicester-Blackface) were used, two groups as controls and the other two receiving dried grass (medium quality) in replacement of one-half of the concentrates of the control ration. In the second experiment (1937-38) there were again four groups, but with 40 head in each group. Both medium-quality and high-quality dried grass were used to replace one-half of the concentrates as in the first experiment, and the fourth group was used to get information as to the effect of replacing the hay allowance (½ lb. per head per day) by medium-quality dried grass. The average results obtained in the two experiments are summarized in the appended Table:—

Experiment	Group	Rations	Av. L.W. Increase per head	Carcass Weight
			lb.	lb.
1 (9 weeks)	I	Growing swedes, hay, concentrates	14	50
	II	As Gp. I, but ½ concentrates replaced by dried grass .	15	50·2
	III	Cut swedes, hay and concentrates	16	52
	IV	As Gp. III, but ½ concentrates replaced by dried grass. .	17	52·8
2 (12 weeks)	I	Cut swedes, hay, concentrates.	17·5	48·2
	II	As Gp. I, but ½ concentrates replaced by high-grade dried grass	24·8	52·5
	III	As Gp. II, but medium-grade dried grass used . .	23·4	52
	IV	As Gp. I, but hay replaced by medium-grade dried grass .	20·7	50·6

It will be seen that in each experiment the use of dried grass effected some improvement in the average growth-rate and carcass weight, this being the more marked in the second experiment, in which the sheep were kept for a longer period. In this experiment also the difference of quality between the two grades of dried grass used was reflected in the results.

Within the limits observed in these experiments dried grass would appear, therefore, to be a very useful component of a ration for sheep that are being fattened on turnips. Whether a larger proportion of dried grass could be used satisfactorily is doubtful, since this raises the difficulties of excessive bulk, slow consumption of the ration, and increased loss of grass from the feeding troughs in windy weather.

Importance of Grass Land. In concluding this summary of the report on the Auchincruive experiments, attention may be directed to a further article in the same issue of the *Transactions* in which Dr. Wright, of the Hannah Dairy Research Institute, discusses the subject of the importance of home-produced feeding-stuffs, with special reference to the conservation of grass. His estimates of the origin and quantities of the food supplies at present available for the nutrition of the country's live stock bring out in striking fashion the predominant importance of grass as the main source of food for British live stock. If, therefore, any attempt is to be made to achieve a greater degree of self-sufficiency in regard to supplies of feeding-stuffs, a large part of our effort must obviously be devoted to grassland production. This involves not only raising the general productivity of our grass land, but also extending and improving the methods of conserving a large part of the herbage for winter feeding. The present position with regard to artificial drying and methods of ensilage is reviewed, and leads to the conclusion that the latter process could at present be more advantageously adopted on a wider scale than the former, which has not yet emerged from the experimental stage. "Increased experience in the management of grass land, better methods of dovetailing the production of dried grass with grazing and with hay-making and other methods of grass conservation, the formulation of improved designs of cutting and collecting equipment and drying plants—all these should play their part in enabling artificial grass-drying to be placed on a more economic basis. But until the above difficulties have been faced and success-

fully overcome, grass-drying is unlikely to develop on a large scale."

As to the scale that would be necessary to provide sufficient dried grass to replace (on protein supply basis) the whole of our imported concentrates other than cereals, Dr. Wright's estimate is that this would require an annual production of roughly two million tons of dried grass with a crude protein content of 20 per cent., or, say, the establishment in Great Britain of at least 20,000 drying plants, with an average output per plant of 100 tons per season, involving a total capital expenditure of not less than £10 million. "A development of this magnitude can hardly be anticipated for many years."

FARMING OVERSEAS

Labour Problems. The shortage of agricultural labour and the drift from the farms are problems which command attention in the Dominions as elsewhere. In South Australia, farmers' sons, it is reported (*Journal of the Department of Agriculture*, April, 1938), do not take up agricultural work with the same readiness that it was customary to find in earlier years. A generation ago many lads in South Australia were said to be in charge of a plough at 10-12 years of age, whereas now a boy will probably not be put to farm work before he is 16, and even then only given odd jobs to do. As a result, he tends to drift away from farm work. What is the remedy? At an agricultural conference recently held in South Australia, the speaker who introduced this subject thought that farmers' sons were not given sufficient responsibility, and he suggested that they should be given a definite share in the farm work and be expected to undertake it on their own initiative. This might give the necessary stimulus and help to keep boys on the farms. "If the Australian farmer's son is encouraged a little there will not be the cry 'Back to the Land.'"

In New Zealand in recent years shortage of farm labour has been responsible either wholly or in part for certain variations from routine practice on what were formerly entirely dairying areas, and one of these changes has been the introduction of breeding ewes and the practice of fattening store lambs in partial substitution of some of the dairy stock. In this connexion the following account, reported in the *New Zealand Department of Agriculture's Journal* for March, 1938, of the method adopted by a Central Taranaki farmer on 162 acres of fairly heavy land may be of interest. No hay or ensilage has been saved for twenty years, and no root crops grown for the past six years. Until this season sixty milking-cows were handled without employing labour, and one hundred ewes were carried. The highest annual butterfat production was 18,000 lb. This is admittedly lower than that of some neighbouring farms, but no harvest costs or labour difficulties were involved. The area is subdivided into fields averaging approximately 11 acres, grazed on about a five-day rotation

according to the season. To cope with surplus growth and weeds on top-dressed fields, the mower is used and the material left for stock to pick up. Top-dressing is at the rate of 3½ cwt.-4 cwt. per acre every second year, and for early spring feed four fields, or approximately 50 acres, are closed in the early autumn and grazed completely off in turn by the cows as they calve. Family labour is now available, and the ewes, which were grazed almost entirely on their own area, except for an occasional clean up of the cow fields, have been sold, and this year seventy-two cows are being milked. This number is to be increased to eighty next season. While the results secured from this method are not claimed to be productive of the highest gross return, it is interesting to note that it has been possible to carry on without employing labour and to keep stock and pastures in very satisfactory condition. The stock winter well on the somewhat rank pastures kept for this purpose.

Pasture Treatment. In very strong contrast with the luscious conditions which obtain on New Zealand pastures are the dry pastures of Victoria. Experimental and demonstration work on pasture improvement has been carried out in Victoria over a number of years under the aegis of the Department of Agriculture, of which an account appears in the April, 1938, issue of the *Journal of the Agricultural Department*. In brief, the aim of this experimental work was to discover how far New Zealand methods and practices would be beneficial under Victoria conditions. New Zealand farmers increase the stock carrying capacity of their pastures by means of increased fertilizer treatment, intensive rotational grazing methods, the sowing of leafier and more prolific pasture species, grass topping, frequent harrowing to promote "soil aeration" and to spread animal droppings, and the use of nitrogenous fertilizer to stimulate out-of-season growth. In Victoria, however, pasture growth under non-irrigated conditions is largely seasonal, being usually completely checked by the dry summer and autumn, the effect of which no fertilizer or pasture-management can overcome. Pasture improvement in this area, therefore, must be confined to increasing growth during the period when soil moisture conditions will permit, or to the growing of a pasture which will be of a higher feeding value when used as dry feed. Dressings of nitrogenous fertilizers have been found to promote extra

grass growth mainly in the early spring, but there is often a severe set-back after cutting because the basal growth is stemmy, and, lacking leaves, recovery is slow. The value of harrowing to distribute animal droppings and to maintain an even uniform sward is admitted generally, but, under Victorian conditions, the use of drastic cutting harrows does not seem to be justified except for special purposes. Again, the seasonal variations in Victoria are too pronounced to enable the system of intensive rotational grazing to be carried out with the dairy herds as a general rule.

From the results recorded and observed throughout this experimental work, it is apparent that the building up of soil fertility by the use of superphosphate must be the basis of all pasture improvement in southern Victoria. When the work was commenced in 1932 no more than one million acres of pasture land were being top-dressed with superphosphate annually in Victoria, while the latest figures indicate that this area has now been extended to 3½ million acres. The early advocacy of top-dressing aroused considerable doubt and opposition, and though some advanced farmers had already learnt the benefits to be obtained from the treatment it is only during the past six years that the large extension has taken place and its value generally recognized.

The *Wiener Landwirtschaftliche Zeitung* (June 11, 1938) draws attention to the profitable returns which can often be secured by a second manuring of meadow land after the first cut has been taken. The cheap rate at which artificial fertilizers can be purchased in central Europe has emphasized the possibilities of this practice. It is said that land which, possibly on account of a lack of fodder, has been cropped or grazed down early in the season well repays a second manuring. But even normally mown meadows repay a second manuring if the latter part of the season after the first cut has been taken is not too dry. Assuming that a complete fertilizer has been applied in the spring, the second manuring will, of course, take the form of a quick-acting nitrogenous fertilizer. Recent demonstration work at Kuchberg showed very clearly the advantage gained by a second manuring. A small experimental plot which received a dressing of sulphate of ammonia as a second dressing at the rate of about 1 cwt. per acre was compared with a control plot which received no nitrogen. The manured plot gave a yield of grass rather more than 30 per cent. in excess of that secured on the

unmanured plot on the same acreage. Taking into account the cost of the fertilizer applied, the additional fodder was obtained at a very reasonable rate.

Electricity for Forcing. A communication made to the French Academy of Agriculture in the spring of this year, and recently reproduced in *L'Agriculture Pratique*, draws attention to some new methods of forcing by means of electricity. Some of these are as yet in the experimental stage, but one that was introduced tentatively 5 or 6 years ago is now reported to be making headway among French horticulturists. This method simply adapts the time honoured method of utilizing the heat of the midden for forcing purposes, supplying the heat by electricity. Electric cables are disposed at the bottom of the "bed," and over them a layer of sand distributes the heat to the soil above. Owing to the fact that the "bed" does not lose heat very rapidly, it is said to be practicable to restrict the use of current to the night time when it is cheapest. This method is well adapted for raising seedlings and cuttings, and for certain special crops.

Maize. In the issue of this JOURNAL for June, 1938, some experimental work designed to discover varieties of maize suitable for cultivation in this country was discussed. In this connexion it is interest to read (*Annales de Gembloux*, June, 1938) that somewhat similar work is in progress in Holland and that encouraging results from the experimental varieties under test are reported.

COUNCIL OF AGRICULTURE FOR ENGLAND

The 50th meeting of the Council was held at the Middlesex Guildhall, Westminster, on Thursday, June 23, 1938, Mr. Robert Bruford (Somerset) being in the Chair. The Minister of Agriculture, Mr. W. S. Morrison, M.P.; the Parliamentary Secretary, the Earl of Feversham; and Sir Donald Fergusson, K.C.B., Permanent Secretary to the Ministry, attended the Meeting on behalf of the Department.

Election of Chairman. Lord Cranworth, M.C., D.L., (East Suffolk) was elected Chairman of the Council for the ensuing year. In Lord Cranworth's absence, the past Chairman presided. Sir Arthur Hazelrigg, Bt., (Leics.) proposed a hearty vote of thanks to Mr. Bruford for his able Chairmanship during the past year. It was carried unanimously.

Election of Standing Committee. The Standing Committee was re-elected for the ensuing year. Its members are:—

Representatives of Landowners. Sir Merrik Burrell, Bt, C B E ; Lord Cranworth, Lord Eltisley, Sir Arthur Hazlerigg, Bt, and Mr Charles Roberts

Representatives of Tenant Farmers: Mr R Bruford, Mr. W. J Cumber, Mr Cecil Robinson, Mr Clement Smith, and Mr R L Walker

Representatives of Workmen. Professor A W Ashby, Mr George Dallas, Mr G E Hewitt, Mr W. R Smith, and Mr Denton Woodhead.

Minister's Address. The Minister, in a review of progress in agricultural affairs since the last meeting in December, said that one of the main points in the Government's policy was the restoration of the land to a state of fertility, and so provide in the soil a store-house of power to produce that which would be of use to the country in whatever circumstances might confront it in the future, whether they be those of peace, as we hope, or of war, which we are doing our best to prevent. First, as regards drainage, a prime essential to production: in the Agriculture Act, 1937, provision had been made for grants to internal Drainage Boards and County Councils for clearing out drains and installing machinery for that purpose. Schemes estimated to cost £194,000 had been approved, in respect of which grants of over £80,000 had been authorized. He observed that the Council had a report before it in which

the dilemma in regard to the limitation of work to the winter months was recognized. He could assure the Council that he would do everything in his power to help Drainage Boards and County Councils to make full use of the assistance now available to them. He hoped that the coming season would show an even better response than the last.

Next, the Scheme for the provision of lime and basic slag: by the end of last month no less than 170,000 contributions had been made to applicants under the Scheme, and some £700,000 had been paid out for lime, and over £220,000 for slag. The Scheme had been in operation only since September 6 last and these figures represented a remarkable response. There was no sign of any slackening. On the contrary, there was every reason to believe that the demand would be intensified, especially in view of the further reduction to be made in the price of basic slag for the year beginning June 1 last.

In the field of animal health, the veterinary services of local authorities had been taken over on April 1 last, as arranged, and he paid a tribute of gratitude and admiration to all those concerned in the operation of transfer, which had been done with smoothness and success. Within a very few hours of its completion, the country had been faced with a dangerous situation as regards Foot-and-Mouth Disease, requiring prompt measures for tracing all animals that had been in contact with those dispersed over the country from Banbury Market on March 24. This was promptly met, and with the application of a very drastic Standstill Order, it had been possible to confine what might have been a very serious outbreak to small proportions, so that the menace was met without great loss to the industry.

He was glad to say, also, that the Attested Herds Scheme continued to make satisfactory progress. There were now over 1,700 Attested Herds in England and Wales and about 2,000 other herds undergoing preliminary tests. On July 1 next, a new Scheme would come into operation to include herds other than those of registered milk producers. The present rate of milk bonus would be continued and an alternative provided for a bonus on the cattle in the herd, at the rate of 10*s*. a head at half-yearly intervals subject to a maximum of six half-yearly payments. The owner of each Attested Herd could choose which form of bonus he would receive. The Minister said he had hopes that the Scheme

would be found to be a valuable contribution in the war being made upon the very heavy losses through disease, and that the results would convince customers in the towns that the agricultural community was taking every step open to it to improve the purity and wholesome character of the products offered for their consumption..

On the subject of poultry disease, free blood tests and post-mortem examination would be carried out at the Ministry's Laboratory at Weybridge from July 1 next for the poultry breeding stations accredited, or accepted for a probationary period, under the Accredited Poultry Breeding Stations Scheme.

As regards cereal producers, the extension of the area qualifying for wheat deficiency payments had led to a satisfactory increase of wheat. As regards oats and barley, the insurance provided by the subsidy arrangements under the Agriculture Act had resulted in the payment of some £53,000 to farmers in respect of 100,000 acres of barley and 320,000 acres of oats.

Land and live stock had not been the Government's only concern. The workmen engaged in agriculture had been in the picture, and he had always held that a good agricultural policy should regard as its goal the raising of the status and happiness of the men who live on the land. Wages continue to rise, and the average for adult male workers was now 34*s*. 6½*d*., compared with 33*s*. 7½*d*. in December last. No one realized more clearly than he did that the first step towards obtaining satisfactory remuneration for agricultural workers was to enable farmers to get a better return for their produce so that they could afford to pay decent wages: the Government was trying to effect that by various measures. The drift from the land, however, had been going on for many years, but efforts to give the workers their due part of the proceeds of their labour should not be relaxed, and he was confident that, given mutual understanding and co-operation, a fair balance could be struck.

The Minister said he was aware that the Council appreciated the importance of rural housing, and improvement in this respect was, he thought, one of the most hopeful measures possible to keep men on the land, especially young men and women. The Council would therefore welcome wholeheartedly the steps the Government were taking to increase the supply of suitable homes for rural workers, at rents from

3s. to 4s. a week. Further, the operation of the Housing (Rural Workers) Acts, which provided assistance for the reconditioning of existing cottages, was being extended to 1942.

The Minister then referred to the Hire Purchase Bill which, he expected, would pass into law before the end of this Session; and to the various measures which the Government had taken to assist producers of particular commodities, naming especially the Livestock Industry Act, under which 850,000 fat cattle in England alone had been certified for subsidy at liveweight centres between August 3 last and May 31, 1938, (about 46 per cent. being of quality standard) earning subsidy payments amounting to nearly £2,250,000.

The sheep position was causing him much anxiety; there was a natural tendency to blame it on imports, but the prices of foreign mutton and lamb had remained firm, and imports during the first five months of the year had been somewhat less than the corresponding period of 1937, i.e., 12,600 cwt. of mutton and 14,000 cwt. of lamb. Discussions were being actively pursued with Australia and New Zealand to prevent undue fluctuations in supplies. The most promising thing that home producers could do on their own account at the moment appeared to be to try to improve the competitive strength of their meat by ensuring first, that a type acceptable to the housewife was produced, and, second, to follow the example of competitors and to advertize.

The Bacon Industry Bill would very soon complete its passage through the House of Commons. Its scheme of assistance, insulating the producer on the one hand from the effect of changes in prices of feeding stuffs, and, on the other hand, guaranteeing the curer a figure for the bacon he produces, should give the industry a rest period during which it could expand and place itself on a competitive foundation second to none in the world. Most reluctantly, he had to report that his hopes of introducing bills dealing with milk and the Wheat Act had to be disappointed through lack of Parliamentary time. A short bill on Milk would be introduced for the purpose mainly of carrying over the assistance that had hitherto been provided for the industry for another twelve months.

This brief outline of activities since last December he gave not at all in the spirit of thinking that everything that required to be done had been done. He could only assure the Council that the Government would continue to press forward, he

hoped in the same practical and commonsense way, with the great task of restoring prosperity and stability to our island agriculture.

After the Chairman had allowed one or two questions to be asked and answered by the Minister, *Mr. Walter Smith* proposed a hearty vote of thanks to the Minister for his Address, which was unanimously agreed.

Storage of Wheat in Stack. *Mr. W. J. Cumber* moved the adoption of the Standing Committee's report on the question of the storage of Wheat in Stack and Deficiency Payments under the Wheat Act, 1932. (*See Appendix I.*) He described how he had sold 50 per cent. of his wheat immediately after harvest at about 42*s.*, the price in the following March and April falling, in that particular year, to 34*s.*, and this very fact of a low price at the end of the year had helped him to get a larger subsidy than he otherwise would have done. It did not, however, seem fair to those who had kept their wheat in the stack. If the present scheme were adopted, it would be possible every four months for an average to be taken and made up to the guarantee price for that period. The Standing Committee hoped that when the Wheat Bill did come in some provisions on the lines of this report would be incorporated. *The Minister* said he was much obliged to the Committee for the report, which was a balanced statement drawing attention to the attractions of the proposal and to its difficulties. It certainly would receive careful consideration. He briefly discussed the pros, and cons, of it from the point of view of Defence as well as that of the farmer. The report was adopted.

Sale of Imported Turkeys as English. *Sir Arthur Hazelrigg* moved the adoption of the Standing Committee's report on the sale of imported turkeys as English (*see Appendix II*). *Sir Donald Fergusson* said that the existing Order controlling the marking of imported turkeys was the result of a report of the Merchandise Marks Committee following a Public Enquiry, and that the present system of marking, as adopted thereafter, was the result of an agreement between the National Farmers' Union and the National Poultry Council on the one hand, and the distributors' representatives on the other. If the Marking Order were varied, the same procedure as the original Order had gone through would be required. It might interest the Council to know that in the meantime, and

pending any such action which might be taken by producers, the Ministry had informed the National Farmers' Union that it would consider issuing immediately before next Christmas a notice in the Press drawing attention in general terms to the requirements of the Order. The report was then adopted.

Improvement of Permanent Pastures. *Mr. George Dallas* on behalf of the Standing Committee moved the adoption of the report on this subject (*see Appendix III*). He said that the report was the result of consideration by the Standing Committee of the resolution proposed by Major Nelson Rooke at the last meeting of the Council, and submitted to the Committee for report. The Committee had interviewed certain well-known experts on the subject of improved management of pastures and had come to the conclusions and views set forth in the report. *Mr. R. Anderson* (Northumberland) pleaded for a restoration of the grants to field and tile drainage, which would help in the northern counties considerably.

Mr. A. Symonds (West Suffolk) and *Mr. T. C. Ward* (Salop) also spoke, the latter pleading for improved drainage of much of the land laid down to grass in the past because farmers had been unable to maintain it as arable; good field drains were often present, but at a depth of about 4 ft., and to make them effective partial redigging, finding, and outfall clearing were required. The cost of laying drains at this depth would be £10-£17 an acre. *Mr. A. Matthews* (Hereford) congratulated the Government on its Land Fertility Plan which began with drainage and proceeded to liming and slagging. Given proper grazing, nature would improve the swards thus obtained. *Major S. V. Hotchkin, M.C.* (Lindsey) said that what was wanted was (1) good field drainage, (2) liming, and (3) sowing with the right grasses and cropping in a rotation so that there would be sufficient humus for the growing of large war-time crops.

The Minister expressed his gratitude to the Committee for its report. He agreed with much that had been said in the discussion: it was no good putting lime on water-logged land, and the grazing, when you got it, should be properly managed and conducted. There were two kinds of pasture land, viz., that which could be improved simply by draining, liming and grazing, and other land which required more drastic treatment. He could not, of course, promise subsidies for

anything, but he did agree with the importance of drainage in the field.

The report was put to the meeting and adopted.

Land Drainage. *Mr. R. L. Walker* presented the Standing Committee's report on Land Drainage Work under Part III of the Agriculture Act, 1937. He said that, as drainage work was now getting organized with engineers and proper machinery, scores of men working for internal catchment boards could be released and be available to agriculture if all the Boards were enabled to buy the machines which were available. It was nearly as out of date for a man to go into a large drain with a spade as it was to go into a 30-acre field of wheat with a scythe. In the new Ryedale District of 30,000 acres the drainage rate was 2*s*. 7*d*. in the £, and the main drains were still in a very neglected condition. If such a district could have the benefit of the grants under Part III of the Act right through the year and acquire proper machinery, an immense amount of necessary work could be done and the farmers need not be robbed of their men. The Catchment Boards were preparing the rivers to receive water and it was the internal Boards' business to put it there. He was Chairman of the West Riding Small Holdings Committee with an estate of 15,000 acres of which at least 5,000 acres had been drained in early days and the drains forgotten. These should now be found and opened. It was important to remember that on the deep clays no amount of drainage work could be of use. Another argument for extending the period to the summer was that there was much work that could not possibly be done in winter time. *Mr. C. H. Roberts* agreed and said that in Cumberland snow and mists may render upland drainage impossible in winter, yet this was work of real importance to sheep stock. Surely, where there were large reserves of unemployed men who had never worked on farms but who could, under proper supervision, do the elementary work of clearing out the drains, they should be used. *Mr. T. P. Gilbert* (Kesteven) assured the Minister of his appreciation of the grants that had already been given. With a drainage rate of 5*s*. 8*d*. in the £ on rich land there were still hundreds of acres water-logged, but good headway had been made. As regards drainage machinery plants, these could be installed and worked without a single agricultural labourer being used. For clearing drains a number of

men were kept at work all the year round and much more progress was made in the summer than in the winter. *Mr. W. H. Turner* (West Riding) and *Mr. Christopher Turnor* also spoke on the report, the latter suggesting that the 33 per cent. allowed in respect of ordinary clearing-out work might be increased to 50 per cent., and some arrangements made by which the balance could be supplied on credit repayable over 20 years or even less. *Major S. V. Hotchkin* referred to the drainage of small holdings in Lindsey where a grant had been applied for but not obtained. He would like the Minister to reconsider the matter. *Mr. Dallas,* in winding up the debate, said that the Ministry had done well to protect agriculture from labour depletion by the safeguards in the Scheme, but the need for extension of time where conditions were suitable was felt not only in the northern areas but in the southern areas and in the Fenlands.

The report was put to the meeting and carried.

Hire Purchase and Credit. *Sir Merrik Burrell* moved:—

"That the attention of the Minister of Agriculture be drawn to the growing practice amongst farmers to obtain their requirements, particularly in regard to live stock, by a system of Hire-Purchase, and to the fact that while, in some instances, it may be convenient and not uneconomical to use such a system, in others it is undoubtedly very much the reverse. The Council accordingly recommends that an inquiry be made into the extent of the practice, so far as the industry of agriculture is concerned, with a view to providing an alternative system which will be available to farmers who would, in the absence of it, be driven to make undesirable contracts for hire purchase"

Sir Merrik said that there had been a rapid spread of this practice particularly in regard to purchasing live stock during the last ten years or so. He regarded the beginning of this practice by a farmer as the first step to ruin. The Hire Purchase Bill now before Parliament would probably not be found to give much protection to farmers against themselves. One of the practical difficulties was in the buying and selling of cattle as to which hire purchase instalments had not been fully paid. Buyers were known to have had to pay for the cattle twice over—once to the hire purchaser, and again to the lender who claimed ownership. Then the landlord, who often helped his tenant financially, did not know where he stood as regards probable repayment when hire purchase was also being practised. *Mr. J. M. Eady* (Northants.) seconded the resolution and said he wished to endorse all that Sir Merrik

Burrell had said. He came from a grazing county in which this system of buying was practised extensively, and the people concerned were a danger to themselves and to others. He explained how easy it was for a farmer without money to buy his stock, not only at an increased price per head, but on exorbitant terms of repayment. He did not think that the new Bill would put a stop to the practice and he hoped that the Minister would bring in another to stop it altogether. *Lt.-Col. G. H. Long, O.B.E.*, pleaded for an alternative credit system for farmers who required urgent accommodation in respect of live stock purchased at certain times of the year. The bankers required security, which it was sometimes quite impossible for the farmer to give, so that he had to fall back either on this hire purchase system or, what was almost as bad, on the system of agistment. He wondered whether the State could not give some sort of guarantee to the joint stock bankers in these instances. After all, the local Bank Manager knew his man and could make suitable exceptions. *Mr. T. Quinney* (Birmingham) spoke in favour, but did not think, however, that it would be possible to get much information as to the extent to which this pernicious system had invaded agriculture. The tenant involved would be unlikely to give himself away and there was no published schedule of the firms concerned. *Lord Feversham* said that he agreed that the hire purchase system had grown considerably in recent years in agriculture, and that it had certain very pernicious aspects. He pointed out that the new Bill would impose control in certain matters which had been mentioned in the debate. No Bill, however, could make a man honest if he intended to be dishonest. As regards the proposed enquiry, farmers, like the rest of the community, were prudently wise not to broadcast their liabilities and an effective enquiry would be impracticable. As to an alternative system, the Council would be aware that the National Farmers' Union were preparing a scheme for extending facilities for short term credit. It had not yet been worked out in detail he understood, but the N.F.U. had secured the support in principle of some of the more important bodies affected, e.g., the National Association of Corn and Agricultural Merchants and the Livestock Emergency Committee. The Minister would certainly be prepared to give sympathetic consideration if the parties found it possible to work out a satisfactory plan in detail.

The resolution was put to the meeting and adopted.

Proposed Agricultural Conference. *Major Nelson Rooke* moved:—

"That the Council of Agriculture for England is of opinion that it is urgently necessary in the vital interests of the Nation for a conference to be set up under Government auspices to investigate and recommend upon all possible means which can be adopted to improve the condition of agriculture and of home food production and distribution in this country, and that it be understood from the outset that any reasonable and workable proposals which such conference may recommend shall receive the immediate attention of the Government with a view to their being implemented, further, that the conference shall be composed of experts conversant respectively with each aspect of the Agricultural Industry with powers to co-opt further experts and to hear any witnesses they may think proper"

Major Rooke said that he did not want to be thought ungrateful for what had been done in the past and what was proposed for the future, but his experience from contact with some 40,000 acres in various parts of the West Country had satisfied him that the question of the Government doing something more for agriculture was an urgent one. To rebuild the industry on proper economic lines meant building something which would outlive all other industries. For rearmament, for the luxury industries, goods and plant were being produced that would be useless in a few years time, but an improved agriculture would always yield a profit, yet it was treated like a poor relation in the family of industries. The present season with its drought, and coming at the end of a number of years of difficulty, would probably yield a large crop of retirements and failures and bankruptcies. A conference of each branch of agriculture, set up under Government auspices might do much for the industry at the present time. It should, if constituted, be asked to report quickly upon the more urgent aspects of the present situation, bearing in mind the great risk that was being taken in our not having enough food for an emergency. At present, the number of men on the land was being reduced and the fertility of the soil was, he said, becoming less. He reviewed the chief questions which should be examined, including the possibility of inducing the general public to invest money in agriculture in this country instead of sending it abroad. *Mr. A. Symonds* seconded the resolution. *Mr. C. H. Roberts* said he thought there was some slight confusion in its terms. A conference of two or three days would do no harm, but to formulate the many ideas proposed and to call witnesses on a long stream of subjects must take much time, during which the Minister

or the Government would have a ready reply on nearly all subjects, viz., that a conference of experts was considering the matter and until it had reported it was quite impossible for the Government to anticipate its findings. The reply would also be convenient for political candidates at a General Election. He thought, too, that there might be a Royal Commission concealed in the resolution, and if, therefore, it went through, and he did not know whether it was worth while voting against it, it might, when sent to the Minister, be coupled with the observations which he had expressed, in the light of which he might consider it. *Lord Middleton* (Yorks. E.R.) said he would certainly vote against the resolution. He was not at all in favour of conferences and he did not think that this Council and the other agricultural bodies could provide the Minister with the expert advice he wanted. The Minister's difficulty was not so much the want of information as the fact that his colleagues, and so many others, represented industrial constituencies. *Mr. T. C. Ward* (Salop) proposed as an amendment that the motion be referred to the Standing Committee. This was seconded and Mr. H. C. Gardner (Worcs.) and Mr. H. T. Cox (Herts.) addressed the Council upon it. The amendment was put to the Council and lost. The resolution was then put and also lost.

McCreagh Estate. *Mr. H. W. Thomas* (Hants.) moved:—

"That the attention of the Minister of Agriculture be again called to the condition of the McCreagh Estate in Hampshire, with a view to steps being taken at once to bring this land into cultivation."

The mover said that it would be a national asset at the present time for this 3,000 acres to be cultivated so as to maintain the 60-100 families which formerly lived upon it. He appealed once more to the Ministry to give consideration to the subject. *Mr. R. Anderson* (Northumberland) seconded the resolution. *Mr. John Beard* moved an amendment that the Council "regrets the inability of the Ministry of Agriculture to deal with the McCreagh scandal." He said that the matter had been brought up so many times, and he would like to know the reason why nothing had been done. Why could the County Council not deal with the matter under the Injurious Weeds Regulations? The resolution was duly seconded, and *Mr. Dallas*, speaking upon it, said that there were powers in the Land Utilization Act to deal with the matter if the Government would exercise them. He described the condition of

the estate. *Mr. A. Goddard* and *Professor A. W. Ashby* spoke, the latter giving notice that he would move a further amendment.

Sir Donald Fergusson said that the Ministry had been trying to find some way of getting this land used without going to the point of putting the Land Utilization Act into force and operating that machinery, because there were difficulties, and that machinery might prove very slow and cumbersome. Further, it would be difficult to operate it whilst arbitration proceedings were pending between the Ministry and the owner of the Estate. The Minister had been successful in those arbitration proceedings, and he was now taking the necessary steps to enforce the award. The Ministry had been exploring every possible way of using the land, e.g., with the Hampshire County Council for small holdings; with the Forestry Commission for afforestation; with the Land Settlement Association and the Commissioner for Special Areas for land settlement, but there had been universal reluctance on the part of these Authorities to put money into the Estate. When the present arbitration proceedings had concluded and the award had been enforced, then it would be a question whether in the last resort the Ministry should not operate the Land Utilization Act, though he would be sorry if the Council thought that that would mean a simple solution; it might be a very difficult one.

Mr. Beard's amendment was then put to the meeting and lost. *Professor A. W. Ashby* then moved an amendment: " That this Council requests the Minister of Agriculture to apply the provisions of the Land Utilization Act to the McCreagh Estate at the earliest possible moment." This was seconded, put to the meeting, and carried both as an amendment and as a substantive resolution.

Mutton and Lamb. *Mr. W. W. Sampson* (Dorset) moved:—

" That the Council of Agriculture for England desires to call the attention of the Minister of Agriculture to the disastrous and unexpected drop in the values of mutton and lamb, and to ask whether it would not be possible to stabilize these values, both in the interest of producers and consumers, either by the better control of imports, and/or by subsidy, as in the case of beef. If a subsidy or levy-subsidy is used it should be such as to secure to the producer not less than the cost of production."

Mr. Sampson said that flock masters to-day were in a very desperate position and it was the Council's duty to convince the Minister that something must be done if the sheep

industry is to be maintained in this country. He produced facts and figures in support of the statements in the resolution. The only solution, he thought, was a further control of imports. He fully realized that retail food prices had to be kept down, and he thought it should be possible to stabilize the price of mutton and lamb by letting in only sufficient to maintain a balance. Wool prices were also 50 per cent. down. The time was past when those engaged in the industry could do more for themselves. *Mr. A. Matthews* seconded the resolution, stating that in his district also the price of sheep had fallen seriously. Sheep farmers were dismissing their labourers and going in for ranching. They had the cottages and could get the men, but they had no money to pay them. He suggested that imported lamb should be more definitely marked as such so that the housewife knew when she was buying imported. *Mr. E. Peat* (Derby) agreed, and said that imports should be reduced at least 50 per cent. for six months. He reckoned that sheep yesterday were being sold at 5*d.* to 6*d.* a lb. less than this time last year. He had no consideration for a farmer who turned to ranching, because that would pay neither himself nor the country.

The Minister assured the Council that he was well aware of the considerations that had been urged in this matter: the situation was easier to describe than to solve, e.g., there was the statement that the fall in sheep prices was due to imports, but so far these were less this year than last. It was not the case that nothing had been done to help the sheep farmer, because the system of quantitative regulation of imports had been enforced ever since the Ottawa Agreement Act. Under that Act, a very heavy cut had been made in foreign supplies. With regard to New Zealand and Australian supplies, there was a system by which an agreed quantity each year was sent and no more, and this year the amount imported was actually less than the amount imported last year when the price was very much better. The Ministry was now in the middle of discussions with representatives of the Governments as to a further regulation of Dominion imports. There had also been a heavy fall in world prices of wool, and that was not a matter which one Government alone could put right. There had also been a fall in world prices of other commodities, such as skins, pelts, etc., which would also have its effect. It had been suggested to him, though he did not wish to make the statement on his own authority, that last summer when

prices were relatively good there was a diversion of consuming taste from mutton to other forms of food. These points would show the Council the variety of the circumstances that were operating and it would be understood that the position could not be cured with a stroke of the pen. Taking the industry as a whole, there had been an extremely good lambing season, but that had coincided with a most disastrous spring drought. The Government would continue to keep control of imports, and he would see if there was anything further that could be done to improve the situation in that way, but he would again ask the farmers to do what they could to help themselves. He did not think that Mr. Sampson meant what he said about his being shocked that farmers should be asked to help themselves; and he referred again to advertising the home product in the same way as Canterbury lamb was advertised. *Mr. Sampson* asked whether imported mutton could be more effectively marked. The resolution was then put to the meeting and carried.

Warble Fly. *Mr. W. C. Smart* (Dorset) moved:—

"That the Minister of Agriculture be asked to give powers to Local Authorities to make regulations under the Diseases of Animals Acts to provide that it shall be compulsory in connexion with the Warble Fly (Dressing of Cattle) Order, 1936, for all owners of cattle to give written notification on cards to be provided that they have inspected their animals in each of the four times during the periods laid down in the Order, and in the event of warbles being found that they have given the requisite treatment"

Mr. Smart said that he proposed this resolution because of the very strong opinion expressed in his County that the Order was not being properly observed throughout the country. *Mr. Sampson* seconded the resolution. *Mr. A. Goddard* asked whether it was not a fact that agricultural committees of county councils had already power to do what the resolution suggested. In Worcester and Gloucestershire they had adopted the system suggested. *Lord Feversham* said that in certain counties, e.g., Cheshire, Warwick, Worcester, Yorks. E.R., and some others, special methods had been adopted to obtain voluntary notification of the dressings carried out by stock owners. The resolution was proposing that these notifications should be made compulsory. There were two considerations he would lay before the Council on that proposal, (1) that the Order required the treatment of visibly infected cattle only, and (2)

that if an owner had no infected cattle it would be unreasonable to put him to the trouble of notifying that fact. The Order was comparatively new and there was still some doubt in the minds of many stock owners as to the benefit that came from it. As regards the necessary publicity for this he hoped that the new veterinary service under the Agriculture Act would be able to spread the required information as to the value of the Order in the course of its routine inspections. *Sir Merrik Burrell* also pleaded for time for propaganda. *Mr. C. W. Whatley* (Wilts.) said the trouble about the Order was that alternative methods were proposed. If the Order said one or the other, " squeeze out " or " dress," it would be more likely to be observed. *Mr. J. P. Terry* (Gloucester) asked if the Ministry's graders had instructions to watch infected cattle when they came up for grading. *Lord Feversham* replied in the affirmative and added that local authorities were in the main taking active steps to enforce the Order, and that the Ministry considered it was better observed last year than in the first year of its operation.

The resolution was put to the meeting and lost.

The proceedings then terminated.

APPENDIX I

Report from Standing Committee on the Subject of Deficiency Payments under the Wheat Act, 1932, and the Storage of Wheat in Stack

1 The Standing Committee has had under consideration the question of utilizing the Deficiency Payments under the Wheat Act for the purpose of encouraging farmers to hold their wheat in stack until later in the cereal year than they would otherwise do, thus postponing its sale and use If that object is one which the Government desires to achieve, the Standing Committee would recommend a simple scheme by which the cereal year would be divided into three periods of four months each, namely: September to December, January to April, and May to August, and Deficiency Payments calculated in the first period from the ascertained average price for that period and the standard price; in the second period from the ascertained average price for that period and an increased standard price; and in the third, from the ascertained average price for that period and a still further increased standard price.

2. Such a scheme would, under ordinary conditions, ensure to growers a higher return from their wheat in the later parts of the cereal year than in the earlier. A statement of the quarterly average prices of British wheat in the past six years is appended, from which it will be seen that the usual, though not invariable, course is an upward movement, at a level less than the standard of 10*s*. per cwt. It should be remembered, in this connexion, that since the British price is dependent upon world prices, there is no certainty that there will be an upward movement or that the price level will be below the standard price.

3. If it should be found that the standard price is exceeded by the average price of home-grown wheat for one or more of the four-monthly periods, then, of course, no deficiency payments would fall to be made in that period or periods, and farmers would be left, as they are now, without any financial inducement to vary their own business judgment as to the best time or times in the year at which to sell.

4. Under such a scheme, no guarantee could be given by farmers as to the amount of the crop that would be held till the end of the year, and, insomuch, may not give the Government the necessary assurance that it may think desirable in such a scheme if it is to be adopted as a measure of Defence. The Committee is aware that the subject is a difficult one both from the point of view of the Government and of the farmer, as on the one hand the scheme, if successful, would mean a considerable increase in the total amount of deficiency payments which would have to be defrayed either by raising the rate of quota on flour, or by making special grants from the Exchequer; and, on the other, that the farmer, by holding his wheat when prices at the start of a year may be well over the standard price, may find himself at the end of it selling his crop—diminished by the usual stack wastage, say an average of about 10 per cent.—at a lower price, notwithstanding the extra deficiency payment or subsidy addition But notwithstanding these and other possible objections, there is no doubt that the suggested scheme would, if adopted operate in a normal year such as the present may be from the point of view of wheat supply, in holding a considerably greater quantity of wheat in the stack in this country than would otherwise be the case

June 9, 1938.

QUARTERLY AVERAGE PRICES OF BRITISH WHEAT
FROM 1931–32 TO 1937–38

Year	Aug.–Oct	Nov –Jan.	Feb –April	May–July
	s d.	*s d.*	*s d*	*s. d.*
1931–32 ..	5 7	6 3	5 10	6 3
1932–33 ..	5 10	5 3	5 2	6 2
1933–34 .	5 1	4 5	4 4	5 1
1934–35 .	5 0	4 10	4 8	5 5
1935–36 ..	5 2	5 11	6 4	6 9
1936–37	7 9	9 0	9 4	9 9
1937–38 ..	9 0	8 7	7 10	—

APPENDIX II

Report from the Standing Committee on the Subject of the Sale of Imported Turkeys as English

1. The attention of the Committee has been called to the fact that imported turkeys as to which the Merchandise Marks (Imported Goods) No. 5 Order, 1934, applies—requiring them to be marked legibly and durably in a conspicuous manner as regards the indication of origin by a seal or disc attached to the wing—are sometimes exposed for sale without that marking, and are, in consequence, not infrequently bought as English birds. Apart from the fact that such happenings act adversely on the English turkey trade, particularly at Christmas and immediately thereafter, they are offences against the Order in question and the Merchandise Marks Acts, punishable by penalties as laid down in those Acts.

2. The Committee notice that, in the Order above referred to, the minimum size of the indication of origin by seal or disc on the wing of the bird as prescribed is the same for ducks and fowl as for turkeys, and, being therefore small, may in the case of turkeys easily be overlooked by the retailer and purchaser, or even plucked off with the feathers before the bird comes for retail sale. However that may be, it seems to the Committee probable that for all imported birds, whether ducks, fowls, geese, or turkeys, it would be an advantage to mark them distinctly in one or other of the following ways:—

(1) by fixing the seal or disc named in the Order to the leg of the bird (through the sinews) and not to the wing;

(2) by cutting off on importation the lower part of one leg, or

(3) by marking the fact of importation by means of a rubber stamp on the breast of the bird after it is plucked. Such a stamping would be made in a vegetable ink to which no exception could be taken under the Sale of Food and Drugs Act as regards the possible introduction of deleterious material into the meat as food; it is understood that such an ink can be obtained and is already available to the Trade. The stamping would remain indelible, until the cooking, when it would disappear.

3. The Committee consider that either one of these alternatives would be more certain to give an effective marking to imported poultry than the present method which is found, at any rate, in the case of turkeys, to be unsatisfactory The numerous prosecutions by Local Authorities that take place is evidence of the fact that the Order is not being properly observed, and, to the extent that this may point to improper substitution of imported poultry for home-produced, an amendment appears to be urgently called for. As to a new provision, alternative (2) suggested above would probably be the simplest and best, though the Committee hesitate to recommend one method before another on a question which is really one for decision by experts.

June 9, 1938

APPENDIX III

Report from the Standing Committee on the Subject of Improvement of Permanent Pastures

1. At the last meeting of the Council (December 9, 1937), the following resolution, proposed by Major Nelson Rooke, was referred to the Standing Committee for consideration and report

> "That the Council of Agriculture for England requests the Minister of Agriculture to consider the extension of the Government's proposals for increasing the land fertility of the country by offering a contribution not exceeding, say, £1 per acre, towards the ploughing-up and re-sowing of worn-out permanent pastures, subject to suitable conditions, such as inspection and approval by the County Authority, the use of specified seeds mixtures, and the establishment of a sound pasture."

2. The Standing Committee has examined the general position and finds itself in agreement with the view that the Government might well consider the suggestion put forward in the proposed resolution, if it decided that its duty lies in the direction of giving further encouragement to farmers to increase the production from their grass lands, and is prepared to safeguard the marketing of the increased stock. The financial assistance

already provided in this direction is that authorised by Parts I and III of the Agriculture Act, 1937, (*a*) for improving arterial drainage by way of grants to land drainage authorities or to County Councils, and (*b*) for improving soil fertility by substantial grants towards the cost of lime and basic slag. The grants in both cases are for three years from the passing of the Act subject to extension for two further years if required.

3. In his speech recommending the adoption of the resolution, the mover suggested that it would be in the national interest to increase the inducement to farmers to improve their worn-out permanent pastures by ploughing out and re-seeding them on the lines suggested by Professor Stapledon, of Aberystwyth, and now well-known throughout the country.

4. The Committee has interviewed Professor Stapledon and other experts on grassland cultivation, and has formed certain conclusions which will be set out later in this Report, but it feels that an over-riding consideration from the farmers' point of view is the practical one of what the result would be if all farmers, with State encouragements, proceed to increase fertility and produce more beef, mutton, milk, and other dairy produce, from their grasslands. It is true that the additional quantities as well as the original production would be obtained at a lower cost after the initial outlay for grass improvement had been met, because greater quantities would be produced from a given area, but it is feared that unless the corresponding imports of meat, milk, or dairy produce, from overseas were considerably reduced to make room for the home increase, prices must decline below the lower cost of production and lead directly to a slump and another agricultural depression The farmers who would feel this most would be those farming poor land which is already producing to its limit, and who find present prices only barely sufficient to yield them a profit over cost of production, i e., taking one year with another For these reasons, the Committee does not feel justified in recommending a campaign of grassland improvement, even with a subsidy as suggested in the Resolution, unless the Government is prepared also to make arrangements for holding the market and maintaining a fair price for home produce.

5. Having said so much, and dealt with the proposed Resolution, the Committee thinks that it may be useful to set out certain general considerations on the question of improvement of grass land, irrespective of subsidy or the economic position as regards markets

6. Competent authorities agree that most of our grass lands are capable of improvement if treated by modern methods on lines which have been suggested by Professor Stapledon and others, modified, of course, according to the needs of different areas, dictated by soil and climate. The soils and climate of this country are so varied that a farming practice that is right in one, may be wrong in another, and a method of improving grass land in the West, where there is ample rainfall, may fail entirely in the East where the rainfall is low.

7. First, however, in regard to drainage : adequate and proper drainage is necessary alike to the formation of good grass land as to arable, in whatever part of the country the soil is situated. It is a pre-requisite to the ploughing, liming, and re-seeding, of any poor permanent pasture that may be undertaken. The Committee suggests, therefore, that the drainage position be carefully examined by farmers before any steps are taken or expense incurred in grass improvement. Where there are drains or ditches that want clearing out in order to allow the surface water to get away, this should be done first of all If in any case the outfalls of an old pipe drainage system have to be re-discovered or cleared out before

proper drainage can be re-established this also should be done, and, when found, their position noted on a map of the land for future information. The Committee feels so strongly as to the need for improved arterial drainage, that it is presenting a separate Report to the Council on certain modern aspects of this question, namely, in its relation to the facilities and subsidies given for increasing land fertility under Part I of the Agriculture Act, 1937.

8. Again, on the point of ploughing out permanent pasture it should be said at once that no one would seriously suggest ploughing out the best kinds of old pasture, with their great and well-known qualities, sometimes of irreplaceable value to the grazier. It may, however, be an advantage to plough and re-seed much of the other sorts of permanent pasture, and in some parts of the country to change the farming practice as to grass lands to one of working a succession of arable leys of four or more years' duration. But it will still be a definite requirement on most live-stock farms that there shall be enough old pasture kept to give winter-feeding for stock. A man's success as a feeder may depend on the capacity of his land to carry all the stock he is over-wintering at the lowest cost of bought feeding-stuffs, and for that purpose new pasture will not possess the thickness and density required, nor will there be the large variety of grasses that old well-drained pasture should possess. The new pastures may give first-class feeding from May to September which will be much better than poor permanent grass, but in heavy low-lying districts these pastures might not be able to be used at all during the remainder of the year.

9. It is true also that, where old pastures are overstocked, they tend to become foul and infested with parasitic worms which is one of the chief reasons for the adoption of a ploughing up and re-seeding policy, but some of them would not be so bad if they were "farmed" better, i.e., stocked in turn with different kinds of stock, or used to carry a mixed stock, rank grasses and thistles mown, rabbits and moles kept down, and occasional dressings given of a suitable manure, basic slag, or, in the wetter districts, ground mineral phosphate which carries about twice as much phosphoric acid as does slag. On most soils there comes a time when a good dressing of lime should be given, and, where grass is concerned, the full utilization of lime is difficult. To do good, the lime has to be mixed with the soil, and the mat usually existing on old neglected pasture makes such mixing impossible. The main value of liming being to release the nitrogen and other plant foods in the soil, it is necessary, in some cases, to plough-up, lime, and re-sow. In favour of this operation, it should be said that, with the new and improved strains of wild white clover and perennial and Italian rye grass, it does not take so long to make a sward as with ordinary commercial seeds, and cases are cited where grazing has taken place within 6–8 weeks of sowing. The new grasses will be found to have a high protein value, and on many soils pasturage will be extended at both ends of the year. The new pasture should, however, be used sparingly at first, as, if heavily stocked at any time, it will tend to become foul in the same way as permanent pastures do when proper care is not taken to rest them or to change the kind of stock turned on, from time to time.

10. These general considerations should be borne in mind by farmers in considering a policy of alternate leys in place of the wide breadth of poor permanent pasture now existing up and down the country. Undoubtedly, from the point of view of making the most of the country's land assets and providing an insurance for the future, the position should be taken in hand, and a policy pursued which will amend it; but we do not feel that this is a matter to which the Council of Agriculture can do more than draw the attention of the Government, leaving it to individual farmers to take what action they consider best in their own individual

circumstances. There is no question that ploughing up and re-seeding with good grass seeds, including wild white clover and perennial and Italian rye grass, incidentally getting rid of the weeds, and liming or slagging the soil, will do wonders in many parts of the country. The cautions set out in preceding paragraphs should, however, be borne in mind wherever good old permanent pasture is concerned. Where this is properly farmed, a farmer can equate his stock to his feeding, and nearly always have a reserve of grass for use should he need to hold his stock on to catch a market.

11. The wider adoption of the system of arable ley-farming will offer opportunities also to grow crops suitable for winter feed, such as beans, peas, etc., which have the advantage of escaping the ill effects on other crops of wireworm

12. As regards the supply of seed, there appears to be little doubt from the inquiries we have made that ample supplies of commercial seeds are available—including wild white clover and perennial and Italian rye grass —at prices which give a cost to re-seeding of 30*s*. to £2 per acre. Mixtures of special pedigree strains, or of so-called "indigenous" strains of the kinds used at Aberystwyth would cost more, and probably be found more suitable in many soils for the longer leys. But where shorter leys are aimed at, and there is intention to "farm" the grass land properly, the ordinary mixtures should prove quite satisfactory, especially when local indigenous seeds, usually found attractive to the stock of the district, are included The real test of the relative excellence of different seeds mixtures is the amount of live weight of beef or mutton grown, or the quantity of milk produced, from each on an equal acreage of similar soil. Tests of the merits of various seeds mixtures are, we understand, being made in a number of districts by the Royal Agricultural Society of England.

13. Finally, a word as to tenancy agreement clauses which prohibit the breaking up of grass land. The main reason for these is that the tenant may "cash" the stored-up fertility of a pasture field without paying for it, and thus leave the farm poorer than he found it We think that, in many areas, where conditions are suitable, owners would do well to revise any such clauses so as to authorize the tenant to plough up subject to satisfactory safeguards that re-seeding with an agreed seeds mixture will be immediately undertaken. Such clauses are frequently found to be a real obstacle to proper farming under modern conditions. They may be necessary to prevent spoliation, but they should, in our opinion, be made in a permissive form subject to satisfactory safeguards as suggested.

June 9, 1938.

APPENDIX IV

Report from Standing Committee on the Question of Land Drainage Schemes under Part III of the Agriculture Act, 1937

1. The Standing Committee has considered again the question of the effectiveness of the grants under Part III of the Agriculture Act, 1937, for the purpose of assisting Drainage Authorities (other than Catchment Boards), or County Councils acting as such Drainage Authorities, to carry out Schemes for the improvement of land in need of proper drainage. The Committee understands that up to the present time grants totalling over £80,000 have been approved, either on a 50 per cent. basis applicable in the case of installation of pumping plant or other constructional work, or on a 33⅓ per cent. basis applicable in the case of clearing out or widening of land drains. The Committee understands that the £80,000 is in respect of drainage work estimated to cost about £200,000.

2. The Council will, no doubt, be aware that drainage work in order to qualify for these grants, must be carried out in the winter months of the year, the precise dates being from October 15 to April 30, though this period may be extended in exceptional cases where a scheme has been unavoidably delayed by bad weather or other unforeseen causes. The reason for the period limitation is that, since in most parts of the country the labour employed would be agricultural labour, farming operations would be likely to suffer considerably if the drainage works were continued into the later Spring and Summer periods.

3 The Standing Committee is aware that this provision, in most cases operates as a protection to the farmer, and is, therefore, wisely imposed but the Committee thinks that in some cases the drainage position may be of such importance that the work should be continued beyond the period if the labour is available. It would accordingly recommend that more exceptions be made, so that much more clearing-out of drains and ditches in a district can be undertaken. For instance, the Committee would suggest that wherever there is labour available (especially otherwise unemployed labour) which would not be used for agriculture during the late Spring and Summer seasons, such drainage works should be freely allowed to continue during that period, ranking for subsidy all the time. Each case of exception should, however, be treated separately on its merits, and one of the factors considered should be the need there is for the drainage having regard to the proposed use of subsidised lime or basic slag on the land under the other part of the Fertility Scheme In this way there would be some assurance secured that the money to be spent on lime and slag would not be thrown away, as is likely if such material is put on land in need of drainage

June 9, 1938

MARKETING NOTES

Milk Marketing Scheme. The wholesale price for liquid milk (other than Tuberculin Tested milk) in June, 1938, was 1*s*. 1*d*. per gal., 1*d*. more than in June, 1937; the wholesale price for Tuberculin Tested milk in June, 1938, was 1*s*. 3*d*. per gal.

Pool Prices for June, 1938, are given below, with comparative figures for May, 1938, and June, 1937.

	Pool Prices		
	June 1938 *d.*	*May* 1938 *d*	*June* 1937 *d.*
Northern . .	10¼	10	9¼
North-Western .	10¼	10	9¼
Eastern .	10½	10¼	9¾
East Midland .	10½	10	9¼
West Midland	10	9¾	9
North Wales	10	10	9
South Wales	10¼	10	9¼
Southern	10¾	10½	9¾
Mid-Western	10	9¾	9
Far-Western	10	9¾	9
South-Eastern .	11	10¾	10
Unweighted Average	10.32	10·07	9·32

These prices are exclusive of any premium for special services and level deliveries, and also of the quality bonuses for Accredited and Tuberculin Tested milks. The estimated gallonage on which quality premiums have been earned was 41,962,719.

The inter-regional compensation levy was fixed at 1¼*d*. per gal. compared with 1*d*. per gal. in June, 1937. Sales on wholesale contracts were as follows:—

	June. 1938 (*estimated*) *Gal*	*June*, 1937 (*estimated*) *Gal.*
Liquid . .	52,384,709	48,932,786
Manufacturing . .	37,435,571	37,920,564
	89,820,280	86,853,350
Percentage liquid sales . .	58·32	56·34
Percentage manufacturing sales .	41·68	43·66

The average realization price of manufacturing milk during June was 6.70*d*. per gal. compared with 5.49*d*. per gal. for June, 1937. The quantity of milk manufactured into cheese on farms was 3,511,509 gal. compared with 3,350,095 gal. in the previous month and 3,107,391 gal. in June, 1937.

Regional Election. At a meeting held in the South Eastern Region on July 5, Mr. E. G. Quested was elected a Regional member of the Milk Marketing Board, to fill the vacancy caused by the death of Mr. John Garton.

Bacon Marketing Scheme : *Bacon Sales Quotas.* A reference to the determination by the Bacon Marketing Board of curers' bacon sales quotas for the six months January to June, 1938, appeared in the January, 1938, issue of this JOURNAL.

The Bacon Marketing Board have now determined curers' sales quotas for the three months July to September, 1938. Under this determination, the total quantity of bacon produced from pigs or carcasses of pigs produced in Great Britain which may be sold by registered curers during the above period is 751,178 cwt. The amount of each curer's sales quota has been determined on the same basis as was prescribed for the twelve months ending December 31, 1937; this basis applied also to the six months January to June, 1938.

Milk Acts, 1934 to 1937: *Manufacturing Milk.* The following tables give details of the payments made in respect of manufacturing milk for the first four years of the operation of these Acts. The figures include an allowance for claims not yet received in respect of milk manufactured up to and including March, 1938.

QUANTITIES OF MANUFACTURING MILK ON WHICH PAYMENTS HAVE BEEN MADE AND TOTAL PAYMENTS IN THE DIFFERENT PARTS OF THE UNITED KINGDOM

Year (April-March)	England and Wales	Scotland	Great Britain	Northern Ireland	United Kingdom
		Gallonage (million gal.)			
1934–35	171·7	26·3	198·0	18·3	216·3
1935–36	225·4	27·8	253·2	23·9	277·1
1936–37	182·4	20·3	202·7	25·1	227·8
1937–38	21·3	2·6	23·9	17·8	41·7
TOTALS	600·8	77·0	677·8	84·3	762·1
		Payments (thousand £)			
1934–35	1,112	163	1,275	164	1,439
1935–36	1,065	123	1,188	133	1,321
1936–37	296	33	329	94	423
1937–38	52	7	59	30*	89
TOTALS	2,525	326	2,851	421	3,272

PAYMENTS IN RESPECT OF EACH PRODUCT MANUFACTURED
(*England and Wales only*)

Year (April to March)	Butter		Cheese		Milk Powder		Condensed Milk for Export		Tinned Cream		All Products	
	Gal '000	£ '000	Gal '000	£ '000	Gal '000	£ '000	Gal. '000	£ '000	Gal '000	£ '000	Gal. '000	£ '000
1934–35	57,730	393	94,782	626	9,371	36	7,067	46	2,752	11	171,702	1,112
1935–36 .	98,802	484	104,101	490	12,499	43	9,983	48	—	—	225,385	1,065
1936–37	92,938	156	73,973	116	6,737	10	8,778	14	—	—	182,426	296
1937–38	21,328	52	—	—	—	—	—	—	—	—	21,328	52
TOTALS ..	270,798	1,085	272,856	1,232	28,607	89	25,828	108	2,752	11	600,841	2,525

TOTAL QUANTITIES OF MANUFACTURING MILK, QUANTITIES AND PERCENTAGES OF MILK ON WHICH PAYMENTS HAVE BEEN MADE AND AVERAGE RATES OF PAYMENT PER GAL.
(*England and Wales only*)

Year (April-March)	Total of manufacturing milk	Total on which payments have been made or will be made	Percentage of total on which payments made	Average rate per gal on gallonage assisted	Average rate per gal on all manufacturing milk
	'000 gal	'000 gal	%	d	d
1934–35 ..	262,250	171,702	65·47	1·55	1·02
1935–36	334,538	225,385	67·37	1·13	0·76
1936–37 ..	342,510	182,426	53·26	0·39	0·21
1937–38 .	290,573	21,328	7·34	0·58	0·04
TOTALS ..	1,229,871	600,841	48 85	1·01	0·49

Milk (*Extension and Amendment*) *Act,* 1938. A note on this Act, which extends the main provisions of the Milk Acts, 1934 to 1937, appears on p. 426 of this issue of the JOURNAL.

Milk-in-Schools Scheme. Returns compiled by the Board of Education show that on March 31, 1938, 2,671,921 children in Public Elementary Schools in England and Wales were taking milk under the scheme. This is an increase of about 161,000 over the corresponding figure for the previous year, in spite of the fact that the total number of children on the registers had decreased by about 87,000. The percentage of children taking milk in Public Elementary Schools has therefore gone up from 49.0 to 53.1.

Wheat Act, 1932 : *Sales of Home-Grown Wheat—Cereal Year,* 1937-38. Certificates lodged with the Wheat Commission by registered growers during the period August 1, 1937, to July 1, 1938, cover sales of 22,971,384 cwt. of millable wheat—as compared with 21,842,178 cwt. in the corresponding period (to July 2) in the last cereal year.

Purchase of Stocks of Home-Grown Wheat. Section 1 (3) of the Wheat Act, 1932, as amended by Section 13 (2) of the Agriculture Act, 1937, empowers the Minister by order to require the Flour Millers' Corporation to purchase unsold stocks of home-grown millable wheat up to a maximum of 4,000,000 cwt. if the Wheat Commission in the month of June in any year make a representation to the Minister that it is expedient that this should be done. The Wheat Commission have resolved that no such representation should be made to the Minister in respect of the cereal year 1937-38.

Livestock Industry Act, 1937: *Cattle Subsidy.* The Cattle Subsidy Regulations, 1937, which had been made under Section 6 of the Act in July, 1937, provided that fat cattle certified for subsidy should be divided according to whether they conformed to an "ordinary" or to a "quality" standard. These standards were defined in the Regulations by reference to the description of an animal, i.e., its conformation, finish and ripeness. It was also provided that an animal should be estimated to have a killing-out percentage of not less than 54 per cent. for the ordinary standard and of not less than 57 per cent. for the quality standard.

Experience of the working of the Regulations showed that the last requirement had in practice tended to operate unfairly to certain classes of animals. It had excluded from the quality subsidy a number of young light-weight animals of excellent conformation and finish which were really of quality standard.

As from July 1, those Regulations were superseded by the Cattle Subsidy Regulations, 1938, which were made by Ministers after consultation with the Livestock Commission. Under these revised Regulations the requirement that an animal shall be estimated to have a killing-out percentage of not less than 57 per cent. to be eligible for the quality standard has been withdrawn, and animals are now divided into ordinary and quality standard solely by reference to their conformation, finish and ripeness. It is emphasized that the alteration will involve no lowering of the effective standards of eligibility for subsidy.

Copies of the new Regulations (S.R. and O., 1938, No. 625, price *2d.* net) may be purchased through any bookseller or direct from H.M. Stationery Office.

Slaughterhouse Schemes. The Livestock Commission have

issued a memorandum for the guidance of any local authority or other body who may be contemplating the submission of proposals to the Commission for the design, equipment and management of a central slaughterhouse under Part V of the Livestock Industry Act, 1937. The memorandum is divided into three sections:— (1) Area of a Slaughterhouse Scheme; (2) Principle features and desirable operations; (3) Compensation for closure of Slaughterhouses under a Scheme. The leaflet may be obtained free of charge on application to the Secretary, Livestock Commission, 1, Sanctuary Buildings, Great Smith Street, London, S.W.1.

Potato Marketing Scheme. The Wisbech Factory of the Farmers' Marketing and Supply Co. Ltd., closed down for the season on June 16. Since September 6, 1937, 11,800 tons of potatoes have been processed at the factory (as against 4,972 tons during the 1936-37 operative period), the average weekly throughput being 280 tons.

Sale of "Seconds." Following the Potato Marketing Board's announcement on May 6, referred to in the June issue of this JOURNAL, 2,620 applications for permits to sell "seconds" for human consumption were received by the Board, involving a total quantity of 26,549 tons of potatoes.

Hops Marketing Scheme : *Amendments.* Following a favourable poll of registered producers, the Hops Marketing Board have submitted to the Minister certain amendments of the Hops Marketing Scheme.

Copies of the amendments may be obtained on application to the Secretary, Hops Marketing Board, 30-33, Central Buildings, Southwark Street, London, S.E.1, price 3*d.* per copy (post free), or they may be inspected on personal application at that address, between 10 a.m. and 4 p.m. on any week day other than Saturday and Bank Holiday.

Objections and representations with respect to the said amendments should be addressed to the Secretary, Ministry of Agriculture and Fisheries, 10, Whitehall Place, London, S.W.1, so as to arrive not later than August 24, 1938. Objections must be made in writing, and every objection must state the grounds thereof, and the specific modification required.

Fatstock : *Carcass Sale by Grade and Deadweight.* During the three months ended June 30, 1938, 2,219 cattle,

7,100 sheep and 1,722 pigs were dealt with under the Grade and Deadweight Scheme, as compared with 2,183 cattle, 3,173 sheep and 2,020 pigs dealt with during the three months ended June 30, 1937.

Exhibits of various classes of live animals illustrating the different grades used under the Scheme were staged at the agricultural shows held recently at Leicester (Leicester County), Kettering (Northampton County) and Cardiff (R.A.S.E.). The demonstrations attracted considerable interest. The Grade II bullock exhibited at the R.A.S.E. Show at Cardiff was specially chosen, in collaboration with the Livestock Commission, to illustrate the type of border line animal, just below the standard for Quality grade.

National Mark Beef. During the three months ended June 30, 1938, 83,130 sides (56,977 home killed and 26,153 Scotch killed) were graded and marked with the National Mark.

Marketing Demonstrations. Particulars of exhibits and demonstrations to be staged by the Ministry during August are as follows:—

Show	*Demonstration*
Southport Flower, Southport . August 24–26.	Tomato Grading Demonstrations. Vegetable and General National Mark Produce Exhibits
Sandy .. . August 25	National Mark Vegetables and other Products.

MISCELLANEOUS NOTES

The Agricultural Index Number, June, 1938

The general index number of prices of agricultural produce for June at 124 (base, June, 1911-13=100) is 1 point lower than that of a month ago and 7 points below that recorded for June, 1937. If allowance be made for payments under the Wheat Act, 1932, and the Livestock Industry Act, 1937, the revised index for the month becomes 129. Compared with May, average prices of oats, eggs, cheese, potatoes and clover and meadow hay showed a rise, while those of barley, fat cattle, sheep and pigs, butter and wool declined.

Monthly index numbers of prices of Agricultural Produce. (Corresponding months of 1911–13 = 100.)

Month	1933	1934	1935	1936	1937	1938
January	107	114	117	119	130	134
February . ..	106	112	115	118	129	130
March ..	102	108	112	116	130	126
April .. .	105	111	119	123	140	132
May .. .	102	112	111	115	133	125
June	100	110	111	116	131	124
July ..	101	114	114	117	131	—
August .	105	119	113	119	133	—
September .. .	107	119	120	127	137	—
October .. .	107	114	113	125	131	—
November .	109	114	113	125	133	—
December	110	113	114	126	132	—

Revised monthly index numbers of prices of Agricultural Produce, allowing for payments under the Wheat Act (a) and for the Cattle subsidy (b).

Month	1933	1934	1935	1936	1937	1938
January ..	111	119	124	125	133	138
February .. .	110	117	122	123	133	135
March	106	112	118	122	134	131
April	109	116	126	128	143	137
May . ..	105	116	117	120	136	130
June ..	104	114	117	121	134	129
July	104	117	120	121	134	—
August	108	122	120	124	136	—
September . ..	111	125	128	133	142	—
October	112	121	119	129	134	—
November	113	120	119	129	137	—
December	114	120	120	130	136	—

(*a*) *Commenced August,* 1932 (*b*) *Commenced September,* 1934.

In the following table the monthly index numbers of prices of individual commodities are shown for the months of March, to June, 1938, June, 1937, and June, 1936; base, the corresponding months of 1911-13=100.

Commodity	1938				1937	1936
	June	May	April	Mar.	June	June
Wheat	100	100	100	104	123	84
Barley	138	137	146	153	129	92
Oats	113	111	113	119	120	82
Fat cattle	110	111	115	117	111	98
,, sheep	100	110	119	118	152	131
Bacon pigs	121	124	130	129	114	119
Pork ,,	123	126	132	133	113	112
Eggs	133	133	129	116	129	114
Poultry	130	127	118	136	132	124
Milk	175	175	215	171	162	162
Butter	124	121	111	105	109	98
Cheese	138	128	119	119	122	108
Potatoes	172	170	120	138	189	160
Hay	83	79	76	77	98	83
Wool	89	95	102	104	138	94
Dairy cows	118	116	117	120	115	103
Store cattle	113	112	119	123	117	96
,, sheep	—	90	105	99	132	119
,, pigs	140	140	145	143	127	122

Revised index numbers due to payments under the Wheat Act and to the Cattle subsidy.

Wheat	125	125	131	134	125	115
Fat cattle	123	125	129	132	125	111
General Index	129	130	137	131	134	121

Grain. Both the June average and base price of wheat were unchanged at 7*s.* 11*d.* per cwt. and the index continues at 100. If the deficiency payment under the Wheat Act, 1932, is taken into account, the index is 125. Barley averaged 3*d.* less at 10*s.* 3*d.* per cwt. but, with a relatively greater fall in the base months, the index moves upwards by 1 point. Oats at 8*s.* 6*d.* averaged 3*d.* per cwt. more and the index is 2 points higher. In June, 1937, wheat averaged 9*s.* 9*d.*, barley 9*s.* 7*d.*, and oats 9*s.* per cwt.

Live Stock. The average price of second quality fat cattle was 3*d.* less at 40*s.* 11*d.* per live cwt. and the index falls by 1 point. If the subsidy under the Livestock Industry Act, 1937, is added, the index becomes 123. Fat sheep realized less money, second quality at 7¼*d.* per lb. being 1*d.* lower and the

index shows a reduction of 10 points. Average prices of bacon pigs at 11*s*. 9*d*. and pork pigs at 12*s*. 7*d*. were reduced by 7*d*. and 8*d*. per score (20 lb.) respectively, the relative indices declining by 3 points.

Dairy cows were somewhat dearer during the month and the index moves upwards by 2 points. Rather less money was realized for store cattle but, owing to a greater fall in the base months, the index is 1 point higher. Quotations for store pigs were reduced, but a similar downward movement was recorded in the corresponding months of 1911-13 and the index remains unaltered.

Dairy and Poultry Produce. The regional contract price of liquid milk and also the index were unchanged on the month. Butter was reduced by ½*d*. to 1*s*. 2¼*d*. per lb., but owing to a more pronounced fall in price during the base period, the index appreciates by 3 points. Eggs advanced by 10*d*. to 11*s*. 8*d*. per 120, but with a proportionate upward rise in price during the months of June, 1911-13, the index continues at 133. The average of quotations for cheese was higher at £4 16*s*. per cwt., and the index appreciates by 10 points. The combined index for poultry at 130 compares with 127 a month ago.

Other Commodities. The average price of potatoes increased by 9*s*. to £8 1*s*. 6*d*. per ton, and the index moves upwards by 2 points. Quotations for both clover and meadow hay were on a higher level during June, and this is reflected in the index which is 4 points higher. The price of wool declined to 11⅝*d*. per lb., and the index falls by 6 points.

Wheat Breeding Investigations

A Report published some years ago on Wheat Breeding Investigations, and issued as the Ministry's Research Monograph No. 4, has attracted some attention in recent months on account of the increased interest that is being taken in this subject from both the practical and the scientific angles. There are few subjects, indeed, that rank higher in economic importance to the world than the improvement of the wheat plant, and this publication by Sir Rowland Biffin, F.R.S., and Mr. F. L. Engledow, of Cambridge University, tells its story of wheat improvement in a very interesting way. The Report is illustrated by 30 photographs. Its price is 2*s*. 6*d*. net—or 2*s*. 9*d*. post free (in paper covers), and it is obtainable from H.M. Stationery Office, Adastral House, Kingsway, W.C.2, or through any bookseller.

Agricultural Economics Society Essay Competition, 1937-38

The Agricultural Economics Society announces that the total prize money of £15 offered by the Society in its Essay Competition for 1937-38 has been divided equally between the following three competitors:—

Mr. G. G. Firth, University College, London, for an essay on "Agricultural Tariffs and Quotas in Europe since 1924—Their Growth and Objects."

Mr. W E. Richards, University of Reading, for an essay on "The influence of a more adequate and well-balanced dietary for all classes upon the character of British agricultural output"

Mr. G. D. Salmon, University of Leeds, for an essay on "Social and economic changes in the position of farm workers during the last 20 years"

Export of Breeding Stock

NUMBER AND DECLARED VALUE OF ANIMALS, LIVING, FOR BREEDING EXPORTED FROM THE UNITED KINGDOM DURING 1937 WITH COMPARATIVE FIGURES FOR 1936

(From returns supplied by H.M. Customs and Excise)

Country to which Consigned	1937 (a)		1936	
	No.	Declared Value	No.	Declared Value
Cattle		£		£
Australia .. .	44	9,979	121	13,633
Canada .. .	159	16,435	172	16,040
Eire	189	6,779	194	6,652
New Zealand .	3	570	4	1,169
Kenya	46	2,191	53	1,811
Union of South Africa (ex. S.W. Africa Territory) .. .	113	9,848	96	8,369
Southern Rhodesia .. .	10	1,444	6	727
Newfoundland and Coast of Labrador .. .	—	—	13	1,460
Other British Countries	30	2,007	35	1,909
Argentina .	251	84,110	230	83,289
Brazil	38	3,080	30	1,657
Uruguay	26	5,545	23	5,356
United States of America ..	15	1,415	51	3,860
Soviet Union	12	1,312	—	—
China (ex. Hong Kong, Macao, Manchuria and leased Territories)	20	1,017	—	—
Other Foreign Countries ..	31	2,664	14	818
TOTAL	987	148,396	1,042	146,750

(a) Provisional

Country to which Consigned	1937 (a)		1936	
	No.	Declared Value	No.	Declared Value
Sheep and Lambs		£		£
Australia	104	4,358	75	2,533
Canada	153	3,587	163	2,648
Eire	232	1,968	228	1,222
New Zealand	15	540	14	286
Kenya	3	95	27	389
Union of South Africa (ex. S.W. Africa Territory)	206	2,747	69	904
Other British Countries .. .	6	156	11	261
Argentina	587	11,784	387	10,928
Brazil .. .	22	281	7	93
Chile	24	946	24	782
Uruguay	77	1,287	15	386
United States of America .	63	1,160	20	207
Soviet Union	—	—	2,491	25,746
Finland	1	20	365	4,325
Poland (including Dantzig) .	5	120	22	265
France	14	205	47	634
Belgium	35	289	3	35
Madagascar and Dependencies .	—	—	30	415
Other Foreign Countries ..	21	324	52	770
TOTAL	1,568	29,867	4,050	52,829
Swine				
Australia	24	1,279	17	784
Canada .. .	5	100	17	280
Channel Islands . .	16	226	4	40
Eire	630	3,594	17	371
Malta and Gozo .	—	—	20	300
Kenya	2	46	12	128
Other British Countries . .	19	432	17	366
Latvia	76	1,663	—	—
Lithuania	20	794	—	—
Poland (including Dantzig) .	18	599	3	50
France	11	349	17	272
Switzerland	7	70	14	526
Japan (including Formosa) .	5	130	15	746
Other Foreign Countries .	21	675	42	1,150
TOTAL	854	9,957	195	5,013

(a) Provisional.

Register of Dairy Cattle

Volume XXI of the Register of Dairy Cattle has just been published. It contains particulars of 755 cows in respect of which Certificates of Merit have been awarded by the

Ministry since October 1, 1937, as compared with 766 cows entered in the previous volume. To be eligible for a Certificate of Merit, a cow must have given, during a period of three consecutive Milk Recording Years, not less than the prescribed yield of milk, and must normally have calved not less than three times during those years. The prescribed yields for the three-year period are 30,000 lb. for Friesians; 27,000 lb. for Ayrshires, Blue Albions, Lincoln Red Shorthorns, Red Polls and Shorthorns; 24,000 lb. for all other breeds or types except Dexters; and 21,000 lb. for Dexters.

The Register contains a statement showing the number and distribution of the yields of the cows of the various breeds entered, and the highest yield certified for each breed for the three years ended October 1, 1937. Of these cows, 27 gave over 50,000 lb. of milk during the three years concerned; 48 over 40,000 and under 50,000 lb.; 83 over 35,000 and under 40,000 lb.; 218 between 30,000 and 35,000 lb.; 222 between 27,000 and 30,000 lb.; and 105 between 24,000 and 27,000 lb.

Particulars of pedigree bulls of proved milking strain are also given. The condition of entry of a bull in the Register is that its dam and sire's dam have given the standard yield prescribed for their breed or type in any particular Milk Recording Year. The volume contains entries relating to 15 bulls.

A list of the Milk Recording Societies of England and Wales, with particulars of each Society and the name and address of its Secretary, is included in the Register.

Dairy farmers and others desirous of acquiring high-yielding, milk-recorded cows that have been regular breeders should find the Register a valuable book of reference.

The Register can be obtained through any bookseller, or from H.M. Stationery Office, Adastral House, Kingsway, London, W.C.2, price 1*s.*, post free 1*s.* 3*d.* A copy of the volume is issued free to all members of Milk Recording Societies.

FOOT-AND-MOUTH DISEASE

The two Infected Areas referred to in the July issue of this JOURNAL, viz., the Oxfordshire and Gloucestershire Areas, have been released from restrictions The Oxfordshire Area was released on June 24, and the Gloucestershire Area, after being contracted to an area of 5 miles radius round the two infected premises at Staunton and Redmarley D'Abitot respectively, was released on July 14.

An outbreak of Foot-and-Mouth Disease was confirmed on July 17 at Thorley, Yarmouth, Isle of Wight, and the whole of the island was, therefore, placed under restrictions. An extension of disease was confirmed on July 22

PRICES OF ARTIFICIAL MANURES

Description	Bristol	Hull	L'pool	London	Costs per Unit¶
	Average prices per ton (2,240 lb) during week ended July 13				
	£ s.	£ s	£ s	£ s	s d
Nitrate of Soda (N 15½%) *	8 0c	8 0c	8 0c	8 0c	10 4
,, ,, Granulated (N 16%) *	8 0c	8 0c	8 0c	8 0c	10 0
Nitrate of Lime (N 13%) *	7 7e	7 7e	7 7e	7 7e	11 4
Nitro-Chalk (N 15½%) . *	7 10c	7 10c	7 10c	7 10c	9 9
Sulphate of Ammonia — Neutral (N. 20·6%) . . *	7 14c	7 14c	7 14c	7 14c	7 6
Calcium Cyanamide (N 20 6%) *	7 16d	7 16d	7 16d	7 16d	7 7
Kainite (Pot 14%) . §	2 18	2 15	2 15	2 15	3 11
Potash Salts (Pot 30%) .. §	5 0	5 1	5 0	4 17	3 3
,, ,, (Pot 20%) §	3 15	3 12	3 12	3 12	3 7
Muriate of Potash (Pot 50%) §	8 3	8 8	8 5	8 1	3 3
Sulphate of ,, (Pot 48%) §	9 13	10 0	9 17	9 11	4 0
Basic Slag (P A 15¾%) .. §	2 12b	2 5b	--	2 10b	3 2
,, ,, (P A. 14%) .. .. §	2 8b	2 0b	2 0b	2 6b	3 3
Grd Rock Phosphate (P A 26–27½%) .. .. §	3 7a	3 0a	2 18a	2 10a	1 10
Superphosphate (S P A 16%) §	3 4	—	3 5f	3 2g	3 11
,, (S P A 13¾%) §	3 1	2 17	3 2f	2 19g	4 3
Bone Meal (N 3¾%, P A 20½%) §	—	7 5	7 0h	6 17	—
Steamed Bone Flour (N ¾% P A. 27½–29½%) .. .. §	5 5ι	5 5	4 15h	4 10	—

Abbreviations. N = Nitrogen, P A = Phosphoric Acid, S.P A = Soluble Phosphoric Acid, Pot = Potash.

* Prices are for not less than 6-ton lots, at purchaser's nearest railway station, unless otherwise stated Unit values are calculated on carriage-paid prices

§ Prices are for not less than 2-ton lots, nett cash for prompt delivery f o r in town named, unless otherwise stated Unit values are calculated on f o r prices

a Prices for 4-ton lots f o r Fineness 85% through standard sieve

b Prices for 6-ton lots Prices at Bristol are f o r Bridgwater, at Hull and Liverpool f o r neighbouring works and at London f o r at depots in London district Fineness 80% through standard sieve

c For lots of 4 tons and under 6 tons the price is 1*s* per ton extra, for lots of 2 tons and under 4 tons, 5*s* per ton extra and for lots of 1 ton and under 2 tons, 10*s*. extra

d Delivered in 5-ton lots at purchaser's nearest railway station For lots of 2 tons and under 5 tons the price is 5*s*. per ton extra, for lots of 1 ton and under 2 tons, 10*s* per ton extra and for lots of 4 cwt. and under 1 ton, 20*s* extra.

e For lots of 4 tons and under 6 tons the price is 1*s* per ton extra, for lots of 2 tons and under 4 tons, 5*s*. per ton extra, for lots of 1 ton and under 2 tons 7*s*. 6*d*. per ton extra and for lots of under 1 ton, 20*s* extra

f Prices shown are f.o r. Widnes

g Prices shown are ex works London, f o r southern rails, 1*s* 3*d* extra

h Prices shown are f.o r. Appley Bridge

ι Price shown is f o r. Newport, Mon.

¶ *These are calculated by regarding a ton as comprising* 100 "*units*" (*equal parts of* 22·4 *lb*) *so that a fertilizer, for example, with* 16 *per cent. nitrogen contains* 16 *such* "*units*" *in a ton Then, if the price per ton of such a fertilizer be divided by the percentage figure, the deduced cost is that of a* "*unit*" *of that agent. Those in the table above are based on London prices.* (*For further explanation, see Advisory Leaflet, No.* 146, "*The Valuation of Artificial Manures,*" *obtainable from the Ministry, free of charge*)

Description	Price per ton		Manurial value per ton		Cost of food value per ton		Starch equiv per 100 lb.	Price per unit starch equiv.		Price per lb. starch equiv.	Protein equiv.
	£	s	£	s	£	s.		s	d	d.	%
Wheat, British .	8	0	0	9	7	11	72	2	1	1·12	9·6
Barley, Canadian No 3 Western	7	13	0	9	7	4	71	2	0	1·07	6·2
,, American	7	5†	0	9	6	16	71	1	11	1·03	6·2
,, Australian	8	2§	0	9	7	13	71	2	2	1·16	6·2
,, Persian	7	2*	0	9	6	13	71	1	10	0·98	6·2
Oats, English, white	9	7	0	10	8	17	60	2	11	1·56	7·6
,, ,, black and grey	9	0	0	10	8	10	60	2	10	1·52	7·6
,, Scotch, white	9	7	0	10	8	17	60	2	11	1·56	7·6
,, Canadian— No. 2 Western	9	13*	0	10	9	3	60	3	1	1 65	7·6
,, No 1 feed .	8	7§	0	10	7	17	60	2	7	1·38	7·6
,, Mixed feed	7	12	0	10	7	2	60	2	4	1·25	7·6
,, Argentine	9	0	0	10	8	10	60	2	10	1·52	7·6
Maize, American	6	13	0	7	6	6	78	1	7	0·85	7·6
,, Argentine .	7	3	0	7	6	16	78	1	9	0·94	7·6
,, Danubian Gal Fox	6	8§	0	7	6	1	78	1	7	0·85	7·6
,, Jugoslavian ..	6	15	0	7	6	8	78	1	8	0·89	7·6
,, South African, No 2 White Flat	7	0†	0	7	6	13	78	1	8	0·89	7·6
Peas, Japanese	22	0†	0	16	21	4	69	6	2	3·30	18·1
Dari ..	8	0†	0	8	7	12	74	2	1	1·12	7·2
Milling Offals —											
Bran, British .	7	0	0	17	6	3	43	2	10	1 52	9·9
,, broad .	7	10	0	17	6	13	43	3	1	1·65	10·0
Middlings, fine, imported .	7	10	0	14	6	16	69	2	0	1·07	12·1
Weatings‡	8	0	0	15	7	5	56	2	7	1·38	10 7
,, Superfine‡	8	7	0	14	7	13	69	2	3	1·21	12·1
Pollards, imported .	7	0	0	15	6	5	50	2	6	1·34	11·0
Meal, barley .	8	17	0	9	8	8	71	2	4	1·25	6·2
,, ,, grade II	8	2	0	9	7	13	71	2	2	1·16	6·2
,, maize . .	7	5	0	7	6	18	78	1	9	0·94	7·6
,, ,, germ .	7	5	0	12	6	13	84	1	7	0·85	10·3
,, locust bean .	7	15	0	6	7	9	71	2	1	1·12	3·6
,, bean .	9	7	0	18	8	9	66	2	7	1·38	19·7
,, fish (white) .	15	0	2	6	12	14	59	4	4	2·32	53·0
,, Soya bean (extracted)‡ ..	8	17	1	12	7	5	64	2	3	1·21	38·3
Maize, cooked, flaked	7	15	0	7	7	8	84	1	9	0·94	9·2
,, gluten feed .	7	12	0	14	6	18	76	1	10	0·98	19·2
Linseed cake—											
English, 12% oil .	10	0	1	2	8	18	74	2	5	1·29	24·6
,, 9% ,, .	9	7	1	2	8	5	74	2	3	1·21	24·6
,, 8% ,, .	9	2	1	2	8	0	74	2	2	1·16	24·6

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv
	s	£ s	£ s		s d	d.	%
Cottonseed cake, English, Egyptian seed, 4½ oil . .	5 10	0 19	4 11	42	2 2	1·16	17·3
Cottonseed cake, Egyptian, 4½% oil . .	5 4	0 19	4 5	42	2 0	1·07	17·3
Cottonseed cake, decorticated, 7-8% oil	7 15†	1 10	6 5	68	1 10	0·98	34·7
Cottonseed meal, decorticated, 7-8% oil	7 15†	1 10	6 5	70	1 9	0·94	36·8
Coconut cake, 5% oil	7 10†	0 19	6 11	77	1 8	0·89	16·4
Ground nut cake, 6-7% oil . . .	7 0*	1 0	6 0	57	2 1	1·12	27·3
Ground nut cake, decorticated, 6-7% oil	8 7*	1 10	6 17	73	1 11	1·03	41·3
Ground nut cake, imported decorticated, 6-7% oil . . .	7 7	1 10	5 17	73	1 7	0·85	41·3
Palm kernel cake, 4½-5½% oil . .	7 5†	0 13	6 12	73	1 10	0·98	16·9
Palm-kernel cake meal, 5½% oil	7 10†	0 13	6 17	73	1 11	1·03	16·9
Feeding treacle	5 0	0 9	4 11	51	1 9	0·94	2·7
Brewers' grains, dried ale	6 2	0 12	5 10	48	2 3	1·21	12·5
Brewers' grains, dried porter . .	5 15	0 12	5 3	48	2 2	1·16	12·5

* At Bristol § At Hull † At Liverpool.

‡ In these instances manurial value, starch equivalent and protein equivalent are provisional

NOTE: The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of June, 1938, and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission Buyers can, however, easily compare the relative values of the feeding stuffs on offer at their local market by the method of calculation used in these notes Thus, if linseed cake is offered locally at £11 per ton, then since its manurial value is £1 2*s.* per ton as shown above, the cost of food value per ton is £9 18*s.* Dividing this figure by 74, the starch equivalent of linseed cake as given in the table, the cost per unit of starch equivalent is 2*s.* 8*d.* Dividing this again by 22·4, the number of pounds of starch equivalent in one unit, the cost per lb. of starch equivalent is 1·43*d.* Similar calculations will show the relative cost per lb of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own markets The figures given in the table under the heading manurial value per ton are calculated on the basis of the following unit prices: N., 7*s* 9*d.*; P_2O_5, 2*s* 6*d.*; K_2O, 3*s* 8*d.*

FARM VALUES OF FEEDING STUFFS

The prices, per ton, in respect of the feeding stuffs used as bases of comparison for the purposes of the calculations of the months April to August are as follow —

Commodity	April	May	June	July	August
	£ s.	£ s.	£ s	£ s	£ s.
Barley (imported) .	8 13	8 4	7 14	7 15	7 10
Maize	7 17	8 0	8 8	8 3	7 3
Decorticated ground-nut cake	7 14	7 13	7 11	7 13	7 17
Decorticated cotton-seed cake	7 15	7 15	7 15	7 15	7 15

(Add 10*s* per ton, in each instance, for carriage)

The Table below is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values," which it is recommended should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows, are given in the November, 1936, issue of the Ministry's JOURNAL, p. 816)

FARM VALUES

(*Food Value, per ton, on farm*)

Crop	April	May	June	July	August
	£ s	£ s	£ s.	£ s	£ s.
Wheat ..	8 9	8 7	8 5	8 4	7 13
Oats . ..	7 1	6 19	6 18	6 17	6 7
Barley	8 7	8 4	8 3	8 1	7 9
Potatoes ..	2 2	2 2	2 1	2 1	1 17
Swedes	0 16	0 16	0 16	0 16	0 15
Mangolds	0 16	0 16	0 16	0 16	0 15
Beans	7 14	7 13	7 12	7 12	7 7
Good Meadow Hay ..	4 7	4 6	4 5	4 4	3 18
Good Oat Straw .	2 7	2 6	2 6	2 5	2 2
Good Clover Hay .	4 9	4 8	4 7	4 7	4 2
Vetch and Oat Silage	1 10	1 10	1 10	1 10	1 8
Barley Straw	2 14	2 13	2 13	2 12	2 8
Wheat Straw	1 11	1 10	1 10	1 9	1 7
Bean Straw	2 14	2 13	2 13	2 12	2 8

WIRELESS TALKS, AUGUST, 1938

Station and Date	*Time . p.m*	*Speaker*	*Subject*
West:			
August 4	5 30	A G Street	A Countryman Afield
,, 16	9 35	,,	How to Look at a Farm
,, 18	9 15	A Hurd	For Western Farmers
Scottish:			
August 3	6 10	—	The Mart · An Impression in a Big Agricultural Mart in the North-East of Scotland
Northern Ireland:			
August 8	9 30	P Fitzpatrick	Farmer's Work and Worry.

APPOINTMENTS

COUNTY AGRICULTURAL EDUCATION STAFFS: ENGLAND

Buckingham · Mr P. H. Brown, N.D.H., has been appointed Adviser in Horticulture *vice* Mr. A. E. B Langman

Durham Mr. E. David, B Sc (Agric.), has been appointed Senior Officer for Agricultural Education at the School of Agriculture and in the county

Lancashire Mr. J. Duckett, B.Sc.(Hort), has been appointed Assistant Instructor in Horticulture

Yorkshire Mr. D. F C. Vosper, B.A , has been appointed Assistant Lecturer in Agricultural Engineering and will take up his duties on September 1, 1938.

WALES

Glamorgan Mr. W. M R. Evans, B Sc (Agric), has been appointed Instructor in Agriculture *vice* Mr C. Kinsey, resigned

MINIMUM RATES OF WAGES

Enforcement.—During the month ending July 12, 1938, legal proceedings were taken against 4 employers for failure to pay the minimum rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases follow —

Committee Area	Court	Fines Imposed	Costs Allowed	Arrears of Wages ordered	No. of workers involved
		£ s. d.	£ s. d	£ s d.	
Derby ..	Repton .	1 11 0	5 13 0	9 0 0	1
Hunts	St. Neots ..	6 0 0	—	40 0 0	1
Lancs ..	Liverpool ..	3 0 0	0 11 0	45 13 2	3
Salop ..	Pontesbury	4 0 0	—	60 17 9	2
	TOTALS ..	14 11 0	6 4 0	155 10 11	7

SOME ADDITIONS TO THE LIBRARY

Agriculture, General and Miscellaneous

Hall, Sir A. D.—Our Daily Bread A Geography of Production (x + 169 pp.) London John Murray, 1938, 6*s*.

Midland Agricultural College—Survey Studies, IV.—Farming Forest Sand. Sand Land Farming in the Sherwood Forest Area of Nottinghamshire (72 pp) Loughborough 1938, 2*s* (Second issue with additional chapters.)

The Register of Chartered Surveyors, Chartered Land Agents and of Auctioneers and Estate Agents, 1938 (1,305 pp) London: Thomas Skinner & Co, 20*s*

Encyclopædia Britannica—Book of the Year 1938, Being a Survey of the Principal Persons, Events and Developments in Various Spheres of Knowledge and Affairs during the Year, 1937. (xviii + 742 pp) London The Encyclopædia Britannica Co, 1938, 21*s*

United States Department of Agriculture—Miscellaneous Publication, No. 284 Bibliography on Land Utilization, 1918–36. (iv + 1,508 pp) Washington, 1938. (Great Britain—Section, pp. 968–1,058)

Imperial Bureau of Animal Nutrition.—Technical Communication, No. 10 Table of Composition of Foods (14 pp.) Aberdeen, 1938, 1*s*.

Schmidt, C T.—The Plough and the Sword Labour, Land, and Property in Fascist Italy (vii + 197 pp.) New York: Columbia University Press, London. Oxford University Press, 1938, 12*s* 6*d*.

International Institute of Agriculture—Agricultural Education in the World. Volume III North America. (xv + 277 pp) Rome 1938, 25 *lire* (In French and English)

Agricultural Economics

University of Cambridge Department of Agriculture—Farm Economics Branch Report No. 26 Changes in the Economic Organization of Agriculture A Comparative Study of Conditions in the Eastern Counties of England in 1937 and 1936. (iv + 34 pp) Cambridge, 1938, 1*s*. 6*d*

University of Oxford Agricultural Economics Research Institute—Agricultural Economics, 1913–38: Being the Twenty-fifth Annual Report of the Institute (79 pp). Oxford, 1938

Oxford Agricultural Economics Research Institute—Milk Investigation Scheme. Costs of Milk Production in England and Wales, Interim Report No 2. October 1, 1935 to September 30, 1936. (58 pp.) Oxford, 1938, 1*s*. 6*d*.

Harper Adams Agricultural College. Department of Agricultural Economics.—A Survey of Egg Supplies and Consumption in a Midland Market Town, by *J. B. Butler*. (32 pp.) Newport, 1938.

International Institute of Agriculture.—Contributions to the Study of the Problem of Nutrition. No. 1—Investigations into the Margin between Producers' and Consumers' Prices of Certain Foodstuffs. (102 pp.) Rome, 1937.

Crops, etc.

Imperial Economic Committee.—Grain Crops . A Summary of Figures of Production and Trade relating to Wheat, Wheat Flour, Barley, Oats, Maize, Rye and Rice (84 pp) London H M Stationery Office, 1938, 2*s* 6*d*

Oxford Agricultural Economics Research Institute—Grass-Drying Progress : A Study of Production Costs in 1937. (62 pp) Oxford, 1938, 2*s*.

Institut International d'Agriculture—Les aleurites et l'industrie de l'huile de bois de chine dans le monde (255 pp) Rome, 1938, 20 *lire*.

Dairying

Henderson, H. O., Larson, C W., and Putney, F. S.—Dairy Cattle, Feeding and Management. (Third Edition.) (557 pp) New York : John Wiley & Sons , London Chapman & Hall, 1938, 20*s*.

Agricultural Research Council—A R C. Report Series, No 3 . Dairy Research (101 pp + 1 map) London H M Stationery Office, 1938, 2*s*

Report and Proceedings of the Eleventh World's Dairy Congress. August 22–28, 1937. Volume I, 506 pp , Volume II, 569 pp. , Volume III, 469 pp. ; Volume IV, 377 pp Berlin The General Secretary of the Congress, 1938

Horticulture and Botany

Gathorne-Hardy, R.—Wild Flowers in Britain (vii + 120 pp + 68 plates) London . Batsford, 1938, 8*s* 6*d*

Hadfield, M.—Everyman's Wild Flowers and Trees (vii + 184 pp + 31 plates) London J M Dent & Sons, 1938 6*s*

Bailey, L H.—Manual of Cultivated Plants (851 pp) New York and London Macmillan, 1938, 21*s*

Imperial Bureau of Horticulture and Plantation Crops—Occasional Paper, No 5 The Frameworking of Fruit Trees, by *R J Garner* and *W F Walker.* (19 pp) 1938, 1*s*

Royal Horticultural Society—Index to Journal and Proceedings, 1838–1935 List of Awards, 1859–1935 (ix + 1,678 pp) London · Royal Horticultural Society, 1938, 21*s*.

Live Stock, including Poultry

Brett, W.—Pictorial Poultry-Keeping Gardening and Encyclopædia of Rabbit, Goat and Bee-Keeping, Pig-Keeping, Cow-Keeping and Smallholding's Management (320 pp + 1,200 photographs.) London C. Arthur Pearson, 1938, 5*s*.

Bradley, O C—The Structure of the Fowl. (Second Edition) (xi + 139 pp.) London · Oliver & Boyd, 1938, 7*s* 6*d*

The West of Scotland Agricultural College—Bulletin No 133 Some Further Stock Feeding Trials. I—Indoor Crops—Succulent Fodder in Ten Days and its Value in Beef Production. II—Feeding Trials with Dried Grass, by *W G. R Paterson* Edinburgh, 1938. (Reprinted from Transactions of the Highland Agricultural Society, Scotland, 1938)

Frazier, R. W.—Livestock Industry Act, 1937 (xvi + 174 pp.) London : The Solicitors' Law Stationery Society, 1938, 12*s* 6*d*.

Agricultural Pests

National Research Council of Canada.—Bulletin No. 18 . Chemical Weed Killers. A Review (111 pp.) Ottawa, 1937, 25 *cents*.

Institut International d'Agriculture—La legislation du commerce des plantes dans les differents pays Deuxieme Edition (363 pp.) Rome, 1938, 35 *lire*

NOTICES OF BOOKS

The Agricultural Revolution in Norfolk. By Naomi Riches, Ph.D. Pp. ix + 194 (The University of North Carolina Press, 1937. Price 11*s* 6*d*.)

Norfolk bulks large in the histories of English farming. Miss Riches has done a great deal to put the great names in their proper perspective in the history of Norfolk farming. She points out that turnips were grown at Raynham in 1700 and at Holkham in 1723. Townshend did not therefore introduce them to his own estate, and Coke was very far from settling in a badly farmed district in 1770

Since her work is confined to Norfolk and she has done so much to clarify the legendary history of that county's farming, it would perhaps be too much to expect her to place Norfolk's development against a background of the developments that were taking place in other parts of the country at the same time She does not explain that many other counties were experimenting in the cultivation of turnips and the new grasses, the clovers and rye grass, sainfoin and lucerne, at the same time or even earlier than the Norfolk farmer

Miss Riches has studied new documents and has produced a readable book, presenting a carefully considered picture of the history of the development of Norfolk farming She has placed the almost legendary figures of the leaders of " improvement " in a better perspective than they have hitherto enjoyed, and she has been no less successful in her attempt to produce a history of modern Norfolk farming No future student of the story of our agriculture will be able to afford to neglect her findings It now remains for someone to put her results in a proper perspective against the background of the story of farming in the whole country

The Climate of the British Isles. By E. G Bilham, A.R C Sc , D I C , B Sc Pp xix + 347 (London Macmillan and Co , Ltd., 1938. Price 21*s* net.)

The purpose of this book has been to collect together the essential facts about the climate of the British Isles in a form suitable for the needs of students and others who require information of a fairly comprehensive character. The author's aim has been to survey the facts which have been established as the outcome of official and private meteorological observations over a long period Thus, he aimed to compile " a reasonably complete summary of the main climatic features of our area, within the compass of a volume of moderate size "

Climatology is described by the author as the branch of the science of meteorology mainly concerned with the ascertainment of the normal conditions for different times , that is to say, with the normal weather conditions of various districts, according to geographical or physical factors, at different periods of the year—and even of the day As an illustration from the book, the synoptic meteorologist is concerned with the probability of there being an inch of rain in London to-morrow , the climatologist is concerned about the general probabilty of there being an inch of rain in London on any day. The British climate, being a standard joke, it might be argued that there is no such thing as " normal " weather. Yet it is shown that, though abnormalities undoubtedly occur, the averages over a long term are fairly consistently maintained.

The weather is everybody's business , to few, perhaps, is it more important than to the farmer. Mr. Bilham has not a great deal to say directly to the agriculturist. His subject is so large, and concerns so many different walks in life, that he has addressed himself to all important aspects of the subject, rather than treat of any one aspect in great detail.

In the section dealing with valley climates, however, will be found references to the air currents that are being studied in the investigations now being carried out on behalf of the Ministry into the causes of spring frosts.

The book begins with a brief description of the nature of the accumulated data with which the author has dealt. He then discusses the geographical and environmental factors which affect our climate Characteristic types of weather are then described, with illustrative examples of recent occurrence. The various climatic elements, such as wind, temperature, sunshine and rainfall, are fully discussed, and in a final chapter Mr. Bilham describes the special features presented by the climates of coastal areas, valleys and large towns. The text is supplemented by numerous charts, diagrams and tables, and an Appendix contains detailed climatic tables for about forty representative stations. Bibliographical references, 90 in all, follow each section

Farm and Garden Seeds. By S. P. Mercer, B.Sc. Pp. 205 and 129 illustrations. (London Crosby, Lockwood & Son, Ltd, 1938. Price 10*s*. 6*d*)

In this book, Professor Mercer has provided an extremely interesting account of seeds from every aspect, thereby appealing to a wide circle of readers.

There are five main sections to the book. The first, dealing with "The Nature of a Seed," is excellent, but the second, "Commercial Seed Production," is not quite so good, some of the information upon sources of supply being rather out of date. The statement that "Rough Stalked Meadow Grass is usually of American origin" certainly calls for revision

"Seed Testing" forms the third section and here Professor Mercer must be heartily congratulated on presenting to his readers not only a very interesting account of a rather technical subject, but also a clear statement of the limits of the value of seed analysis

Section four deals with crop and weed seeds and is illustrated by the author's own drawings The latter are well above average merit and support the view that a good drawing is more informative than a second-rate photograph It is rather unfortunate that no scale is attached to the illustrations. Dimension of the seeds can be found by careful search elsewhere in the book, but it is confusing to see, for example, Corn Cockle and Chickweed figured the same size.

The final section deals with the Provision and Administration of the Seeds Act and is contributed by Mr A W. Monro, C B. The information given appears to be just what readers should require.

Agricultural Economics, 1913–1938. The 25th Annual Report of the Agricultural Economics Research Institute. Pp 79. (Oxford. 1938. Price 2*s*. 6*d*)

Under this title, a review of the work of the Agricultural Economics Research Institute, Oxford, has been issued on the occasion of the 25th anniversary of its foundation. The Institute was the first place organized in this country for the investigation of the economic problems of the land, and this report summarizes in a very readable and attractive manner the progress made in the different branches of the work. Beginning with farm management efficiency studies, the work has been extended to the more fundamental problems of agricultural policy, prices and supplies, and the economics of new technical processes such as mechanized corn growing, milk production and grass drying. Some historical research is included, and the investigation of social economics is represented by studies of rural industries, rural migration and land settlement.

Year-Book of Agricultural Co-operation, 1938 Edited by the Horace Plunkett Foundation Pp vi + 564. (London: P. S. King & Son. 1938. Price 15s)

This volume for 1938 completes a decade of worldwide surveys of the progress of agricultural co-operation, and reviews, in a series of chapters written by contributors with special knowledge of their subject, recent achievements in the many countries where the co-operative movement has taken root In addition, there are interesting chapters on the relationship of co-operation to the nutrition of colonial peoples and to rural hygiene, and, appreciations of Count Alexander Karolyi—the father of the Hungarian movement—and of the late M Albert Thomas, Director-General of the International Labour Office and one of the leading figures in the modern co-operative movement A summary of co-operative legislation in 1936-37 is given, together with reviews of recent books and other publications and a selected bibliography of co-operative literature

The English section is mainly devoted to an analysis of the Registrar of Industrial and Provident Societies' returns for the year ended March, 1937

As regards Northern Ireland, the potentialities of the Pig Marketing Associations and the activities of the co-operative creameries are reviewed The chapter on Scotland surveys the activities of the past ten years and refers to the comparatively new venture in egg marketing by way of cartons packed under members' personal guarantee The Welsh chapter shows the progress made between 1935 and 1936 in membership, turnover and profits, and comments upon the value of the work of the Welsh Agricultural Organization Society.

The survey of overseas developments tends to show that, in every country where the movement substantially retained its freedom and escaped the disaster of war or natural calamity, the ground held in 1936 was extended during the ensuing year. Apprehension is expressed concerning the position in China where, according to a most informative chapter by the co-operative adviser to the Government of that country under the auspices of the League of Nations, the movement was in a fair way to bring great benefits to the population On the other hand, in Catalonia interesting developments are taking place under the stress of war

For the most part, co-operation is held to have made definite progress during the period under review, recovery from the world depression having found co-operatives ready to act with renewed energy

Pig Breeders' Annual, 1938–39 Pp 270 Illus (National Pig Breeders' Association 1938 Price (to non-members), 2s 6d., by post 3s.)

The subjects dealt with in this, the eighteenth volume, include "The Management of a Breeding Herd," by Mr S H Hart; "The Progress of Danish Pig Breeding," by Dr. Clausen; "Mortality in Pig Production," by Mr A. W. Menzies Kitchin, Cambridge School of Agriculture, "The Experiences in Judging Pig Carcasses," by Mr H R Davidson, "Tethering System of Pig Breeding," by Mr R B Peacock, of Cambridge; "The Grocer's View of Pig Production"; "Costs—a Breeder's Experiences," and a "Review of the Australian Show System." Dr. K. A H Murray of the Agricultural Economics Research Institute, Oxford, contributes a comprehensive "Survey of the Pig Industry in 1937," and the regular features—perhaps the most interesting and valuable section of this annual publication—include summaries of research and experimental work carried out during the past year, and notes on the progress of the pig industries in the principal pig producing countries of the world. An enlarged statistical section, with pig feeding tables, is also included.

Notices of Books

Guide to Official Statistics. Pp. 406. (London: His Majesty's Stationery Office. 1938. Price 1*s.*, by post 1*s.* 5*d.*)

This index, which is issued annually, provides a ready means of ascertaining the nature of the information available on any subject and the official publication in which it is contained. This, the sixteenth volume, refers to statistics published in 1937.

A History of the New Zealand Dairy Industry By H. G. Philpott. Pp. 413 (Wellington Government Printers. 1938 Price not stated.)

This volume gives an account of the rise of the Dairy Industry in New Zealand from the colonization in 1840, up to 1935. The soil and climate of the Dominion have proved eminently suitable for Dairy Farming, and the industry has naturally become the corner stone of the economic edifice there The principal causes of progress therein are claimed to be co-operative methods, combined with sustained govermental encouragement, although due tribute is also paid to private traders' enterprises.

In 1892, the first Dairy Industry Act was passed to regulate the manufacture of butter and cheese for export, and to provide for the purity of the milk so utilized The Dairy Industry Act of 1908 is regarded as the basis of present-day administration of the industry The post-war era saw great increases in efficiency, due largely to Herd Testing and the use on the grassland of phosphatic fertilizers derived from the Ocean Islands.

The Dairy Produce Export Control Act of 1923 extended the government's control; the experiment of "standardized cheese" was attempted, but was rapidly discarded in favour of the full-cream variety The Dairy Industry Commission of 1934 led to the Primary Products Marketing Act of 1936, a summary of which is given

At the present time, the 500 or more creameries and milk factories have an exportable capacity of 140,000 tons of butter and 100,000 tons of cheese per annum; and the limit of productive ability is not yet in sight. The book concludes with a short chapter on the Maori Dairy Farmers.

Milk Products, By W Clume and H. Hill Pp. 387. Illustrated. (London H K. Lewis & Co, Ltd 1937 Price 21*s*)

This volume, although well described by its authors as a Public Health Textbook, is a book that will find a sphere of usefulness beyond that of the Public Health Service, and students of dairying in particular will find that its contents are well worth a close study

Its eight chapters each deal with a separate milk product, and each chapter is compiled on a standard plan which facilitates reference and comparison. The technical material is well arranged, and is generously provided with clear illustrations and diagrams of the machinery and processes employed in the modern manufacture of milk products.

The authors rightly stress the essential need for the use of steam for the purpose of sterilizing the equipment used in these manufactures, subsequent to the cleaning thereof, and it is satisfactory to learn that, as yet, no definite outbreaks of disease have been traced to the consumption by the public of butter, condensed, evaporated, or of dried, milks.

A notable omission from the text is any adequate mention of the National Mark standards of quality, now in voluntary operation for butter and certain varieties of cheese.

Excerpts from the relative Public Health Legislation form a valuable feature in each section.

Notices of Books

The Wasted Land. By Gerald W. Johnson. Pp. vi + 100. (University of North Carolina Press, Chapel Hill. 1937. Price $1.50.)

Ever since England had to legislate against the growing of tobacco at home in order to protect the "Plantations," the single crop economy of the South-East States of America has gathered difficulties round it. The tobacco lands were devastated by continuous cropping and became successively derelict as the growers moved along. After tobacco came cotton, again as a single-crop economy, and the culminative effect of some centuries' work along these lines has led to nothing short of disaster.

Fortunately for us in England, we have no such titanic problem of combating the results of farming for immediate profits and taking absolutely no thought for the morrow. Our land was always too limited in relation to the numbers of the population to allow us to be so extravagant, although sporadically foolish attempts have been made to cash the accumulated fertility of the soil and leave the future in the hands of destiny.

How shortsighted such a policy is, is shown only too clearly by this study of existing conditions in the south-east of the United States Here an area double the size of England and Wales has been rendered useless by soil erosion, leaching and over-cropping. More than the total number of people engaged in farming in England and Wales have emigrated from the district to seek employment elsewhere Yet Mr Johnson shows that the country is capable of growing all the crops that flourish in the States and he does not despair of finding a remedy for the present appalling state of things. The problem is, of course, made more difficult by the fact that one-third of the population are negroes, but even the conflict of races can be overcome, Johnson suggests, by an appropriate approach.

The book is really a commentary on a larger study of the same subject, *Southern Regions of the United States*, by Howard W Odum

Laboratory Manual of Agricultural Chemistry. By C. C Hedges and H R Brayton Pp x + 74 + blank pages for notes. (New York and London · D Appleton Century Company. Price 4*s*)

This is a book for students in agriculture and for those commencing a course in agricultural chemistry The first part deals with the preparation of standard solutions and with some simple analyses, and it is therefore not essential that students should have previous experience in quantitative analyses but only that the practical work should be accompanied by lectures in the theory of agricultural chemistry. The main part of the book takes the student through a course of analyses of feeding stuffs, soils, fertilizers, insecticides, fungicides, milk and drinking waters. As the book is written from an American standpoint, the methods of analysis do not necessarily include those used officially in England It is suggested that in a future edition the section on tests for soil acidity or alkalinity could with advantage be expanded to include the conception of pH and methods for determining soil reaction by indicators. The book is well printed and free from errors and thoughtful provision for students' note has been made by the insertion of a blank sheet between every page of text.

Our Daily Bread. By Sir A. D. Hall, K.C.B., F.R S. Pp. x + 169 Illus. (London : John Murray. 1938. Price 6*s*.)

For some time past the feeling has been growing that there exists a serious gap in our literature and school text-books on subjects that explain in simple language to town-bred children the life of the countryside.

Some years ago the late Professor T. B. Wood issued a little book on "the story of a loaf of bread," which gave a useful introduction to the various problems encountered, e.g., by the scientific worker in breeding suitable kinds of wheat, by the farmer in cultivating the growing crop, and by the miller in producing a flour of the requisite baking quality. Although this book met with some success, it was limited in scope, and can now perhaps be regarded in the light of an advance guard to more recent attempts of a similar kind A little later, Sir Daniel Hall, in an address to the Gilbert White Fellowship, subsequently reprinted in his *Digressions of a Man of Science*, advocated the production of a school reading book which should be a kind of anthology of passages in moving and eloquent language, of which he gave some illustrations, on rural scenes and rural life. It was probably due to the inspiration of this address that led to the suggestion being made to Sir Daniel Hall to write a book for school children, and particularly for town-bred children, telling the story that goes to the production of the common foods which appear on our tables every day This Sir Daniel has admirably performed in the little book under review. The brief talks which are the subject of successive chapters, e g , on wheat cultivation and bread making , on milk and the breeds of cows and their management and the problem of cleanliness , pig-keeping and the production of bacon ; sheep and their history ; beef cattle, and so on, to the produce that reaches our tables from overseas, e g., tea, coffee, oranges, spices, etc.—all are very charming vignettes which are satisfactory in giving just the sort of information which a boy or girl would want to have in order to know how our food is produced. The book is profusely and delightfully illustrated It should admirably fulfil its purpose. No one, young or old, will be likely to discard it feeling that the author has been talking down to him

Grass-Drying Progress. A Study of Production Costs in 1937. By R. N. Dixey and W F. Darke. Pp. 62 (Agricultural Economics Research Institute, Parks Road, Oxford, 1938 Price 2*s*)

It is now two years since the artificial drying of grass became a subject of general farming interest During that period there has been a good deal of conflicting evidence as to the value of the process

The enthusiasm of the early months of 1936 was checked when it was found that dried grass was costing about £6 a ton to produce, and that its quality was generally inferior to that which farmers had been led to expect. The 1937 season provided the opportunity for further trial, the results of which, as found by detailed analysis of costs, incurred with different makes of machine in various parts of the country, are discussed in this report.

It appears that grass-drying need be regarded no longer as a semi-industrial process round which the farm must be made to revolve, but rather as one of the many activities which go to make up the ordinary farming routine. Provided that an efficient drier be installed, a product which compares favourably with the more common feeding stuffs can be produced at something less than £5 a ton.

In the light of these results, it would seem that the disappointment engendered by earlier experiences has gone too far and that grass-drying may yet prove itself to be a valuable undertaking

The A.B.C. of Agrobiology. By O. W. Willcox, Ph.D Pp. 323 (London : Allen & Unwin, Ltd. 1938. Price 12*s*. 6*d*.)

Agrobiology is concerned with the mathematics of plant growth under ideal (i.e., practically unattainable) climatic and soil conditions. Calculations based on the growth-curves of Mitscherlich show that agriculture

could be far more productive than it is, were it not for the factors limiting plant growth, i.e., the shortcomings of climate and soil with which the grower has to deal.

Harmful soil conditions, acidity, poor drainage, unavailability of nutrients, climatic changes, insect pests and disease, in fact, anything that causes the crop to fall short of the theoretically possible maximum yield, are stated to be outside the agrobiologist's province. It is unfortunate that these things happen to be the chief concern of gardeners, farmers and the more practical of the general readers to whom the book is addressed

Throughout the 300-odd pages of the book, prescriptions for 100 per cent. yields, based on the laws of plant growth, are characterized by a beguiling arithmetical simplicity; but it is questionable whether some of the assumptions on which agrobiological reasoning is based fit the facts of plant physiology. The agrobiologic theories set out in this book do, however, provide the plant physiologist and the plant breeder with a good deal of food for thought

Mother Earth. By G W. Robinson Pp. vii + 202. (London: Murby and Co. 1937. Price 5*s*. 6*d*)

A philosophical outlook is particularly evident in these sixteen essays on soil. They are written in the form of letters addressed to Prof. R. G. Stapledon, and in each of them Prof Robinson has something enlightening to say about the different aspects of what he considers as an essentially homely subject.

He believes that many of the failures of the scientific approach to soil problems have been due to the mistake of confusing soil material (the laboratory sample) with soil in the field, where in its natural habitat it lives and is subject to slow secular changes that must be understood if its fertility is to be maintained Soil material, humus, structure and tilth, soil profile and soil moisture are discussed in turn, and in a way that allows the reader to see the relation which the different aspects of soil bear to one another.

Perhaps the most original of the letters are those dealing with our soil resources in relation to their utilization and conservation. The importance of lime and the temporary ley is given special emphasis, and a plea is made for their greater use in Britain In a later essay the relation between arable, grass, forest and waste land is clearly explained. In the last of the series Prof. Robinson discusses the dangers of exploiting soil capital, and draws a moral from the spectacular losses of soil fertility that have occurred in America and elsewhere through soil erosion He points out that, whilst in this country soil erosion is not prevalent to any great extent, evidence is not lacking of other forms of soil deterioration on which a close watch should be kept.

Applied Mycology and Bacteriology. By L D Galloway and R Burgess Pp. ix + 186. (London: Leonard Hill Limited. 1937. Price 10*s*)

This book is intended primarily for the industrial microbiologist and is an attempt to indicate the scope and methods of economic microbiology. It is divided into two parts. In the first or general part (91 pages) the main groups into which fungi and bacteria are classified, and the apparatus and methods used for studying them in the laboratory, are briefly discussed. In the second or special part the rôle of microorganisms in the food, fermentation and textile industries is dealt with, and chapters are devoted to medical microbiology and to the agricultural aspects of the subject. The volume provides only the essential facts, but it may serve as a useful introduction to the extensive but rather scattered literature on the subject. To this end a selected list of references, mainly to readily accessible literature, is given at the end of each chapter.

Commercial Apple Growing By A. H. Hoare. With a foreword by Dr. H. V. Taylor. Pp. 245. Illustrated (London: Martin Hopkinson. 1937. Price 10s.)

Those who are thinking of entering upon the business of growing apples for market are anxious for information on the selection of land, planning the plantation, choice of varieties, and the amount of capital required They want also to gain an idea of the routine work they would be called upon to carry out in the management of the plantation and the marketing of the crop They will find such information ably presented in this book by an author who has been officially connected with the industry for more than twenty years and at the same time closely associated with modern research work He has had ample opportunity to see how the business is conducted on successful holdings, large and small, in Kent and the Eastern Counties, and has given brief descriptions of a selection of such plantations, which will help the beginner to decide on the scope and lay-out of his own place

Sound advice is given on the selection of a situation with a view to escaping frost and on the choice of soil Up-to-date planting schemes are discussed and illustrated and the preparation of the land described The grower is wisely recommended to aim at the bulk production of not more than four varieties With regard to the routine work of the plantation, the author has dealt rather briefly with pruning, but has given sound advice on manuring There is a useful chapter on orchard soil management in which the merits and application of the clean and partial cultivation and sod methods are discussed Pests and diseases and their control by modern methods of spraying are dealt with adequately. There is a useful chapter on the keeping of apples in ventilated, cold, and gas stores Enough is said about packing and marketing to give beginners an idea of the methods followed on modern fruit farms. The directions for carrying out some of the minor practical operations, such as grafting and ringing, are not full enough to enable any one to follow them and are not free from errors

The book is obviously intended to serve as an introduction to the subject of commercial apple-growing, and as such can be recommended

Mechanized Corn Growing. By A Bridges and E P. Weeks Pp. 68. (Oxford: The Agricultural Economics Research Institute 1937. Price 2s 6d)

Full factual information is given in this publication for eleven farms over the three years 1934–5–6 All are on lightish land, from 500 to 1,100 acres in size, and in no instance is there any significant head of stock (save pigs in some). The kinds of machine, working rates, labour charges and harvesting costs are dealt with in full. A cost-comparison between the use of combine and binder is given Very broadly speaking, wheat was taken on 40–50 per cent. and barley on 20–30, per cent of the land, about 30 per cent was fallowed and small areas of beet and seeds hay were grown on some.

As the "accounts (kept by the farms) did not reflect the position under normal working conditions" the financial results could not be estimated. The substitution of seeds and bastard fallow for bare fallow (possibly with mustard) is thought to be the most important development in cropping policy. "The seeds provide an extra cash crop . . ." This extra cash would naturally fail if the system became at all common

The investigators' object was to provide reliable factual information, and what they have amassed makes very interesting study. In a few places they disclose certain views about the prospects of this kind of

farming. In these a cautious optimism is evident, though they make clear that at present mechanized corn growing is an unimportant element in British farming. The years in question, even 1936, were not a stern test so far as weather was concerned and, in any event, many policies in farming can run well for a few years but no more. It is impossible to ignore this fact in reading, that " besides direct manuring with artificials fertility was also maintained by fallows and by ploughing in green manure crops " Fallowing on the scale used on these farms is waste of land and their use of green manure cannot be vindicated by the results of three years. A watch on disease (Root-rot and Take-all groups) would have added to the value of the study, though this was not, of course, within the scope of an enquiry into immediate economic facts Yields so far obtained show that disease cannot as yet have been heavy.

Crop Management and Soil Cultivation. By J. F. Cox and L. E. Jackson. Pp 610 illus. (New York and London · Chapman & Hall 1937 Price 13*s*. 6*d*.)

Soil erosion by the interplay of wind and rain with certain systems of agriculture has been a gloomy pre-occupation of science for many years In the United States, after long general, light-hearted neglect, it was almost suddenly transmuted into a prime question, not only for Government, but in the press and among all sections of the farming community by the impact of the world depression of 1931 and the severe droughts of the following years The awakening brought into being the vast measures for farm relief and land conservation, which we in Britain now watch with increasing attention

This volume ranges widely, seeking to present to the elementary student the basic principles and facts of crop-botany, prevention of pests and diseases, cultivation practices, soil science, and the growing and utilization of the chief crops of the U.S.A. In places the practical philosophy may seem faulty; and the almost casual way in which fundamental relations between crops and stocks are handled is bound to surprise the British reader; but to have all through it a burning theme and a great national aspiration for the land is to have what most text-books on agriculture on both side of the Atlantic sadly lack and sorely need.

As a text for routine teaching it is naturally not adapted for British use. For farmers, however, many of the general chapters give a succinct and intriguing account of the great transatlantic agriculture by which their own destinies have been profoundly influenced. Its magnitude, its diversity, and, perhaps most of all, its rashness, make impressive reading. The lessons fit the stage of development reached by U.S.A. farming where . . " the practice of growing the same crop on the land year after year is fast changing to the practice of growing crops in rotation " To hear others speak of the ways in which they have gone wrong will no doubt excite again the growing doubt about the soundness of our own post-War trends in farming practice and policy.

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NOTES FOR THE MONTH

Agriculture at the British Association

At the meeting of the British Association held at Cambridge from August 17 to 24, the agricultural section was convened under the presidency of Professor R. G. Stapledon of Aberystwyth, whose address under the title "Ley Farming and a Long-term Agricultural Policy" was received with great interest. It will only be possible in this note to indicate some of the main points in Professor Stapledon's paper.

Professor Stapledon's principal contention is that it would be advisable, particularly in the national interest, to plough up a large proportion of the present area under permanent grass and to introduce a more extensive system of ley farming or alternate husbandry. "The needs of our people are abundance of fresh food—and that is not compatible with a superabundance of permanent grass." Professor Stapledon went on to enumerate the many serious defects which he sees in permanent grass farming, e.g., it contributes nothing more valuable than inferior hay to the winter ration; it affords the minimum of flexibility and maintains the minimum acreage in a ploughable condition. Permanent grass farms "are an excuse for an immense amount of laxity both private and national," although even the worst of them generally have some slight earning capacity and that with the minimum of trouble. They often need lime and drainage and many are wasteful of manurial residues. "There is only one correct and entirely satisfactory way to apply lime, and that is under the plough." Then again, permanent grass harbours many of the organisms of disease. Another of Professor Stapledon's criticisms of permanent grass is that it does not make, as a rule, really good silage or good dried grass. Considered as

grass, it is far too weedy and much more weedy than first-class leys, and even the best permanent grass has a shorter growing season than can be arranged for by a sequence of good leys.

The conclusion at which Professor Stapledon arrives is that at the very least 3 million acres of ploughable permanent grass should be condemned.

To remedy this state of things, he recommends the adoption of ley farming or alternate husbandry, under which, apart from, say, a couple of fields of permanent grass, the ley farmer takes the plough in ordered sequence around the whole farm. Ley-farming is of two main types—one may be defined as the *arable-grass* rotation, in which the area in grass at any time will not exceed 50 per cent. of the farm, and may be somewhat less; and the other as the *grass-arable* rotation, in which as much as three-quarters or even more of the farm will be in leys at any one time. Examples of the first type are to be found in the arable dairy farming of Denmark and the rotations usual in Aberdeenshire for beef production. In the second type, ordinary animal products and the practice of dairy bailing, poultry and pig folding are the major concern, and these farms can be turned over at a moment's notice to large-scale cereal production.

In both types, "always the majority of the leys employed will be of two or more years' duration, and always in any particular year the area of the farm in leys (and therefore in grass) will not be less than one-third of the ploughable acreage; will frequently be over three-quarters of that acreage, and in extreme cases, and at unusual periods, the whole of the farm may be in leys. The main points to be emphasized are these. The ley-farmer is of necessity, and essentially, a grazier, and a crop husbandryman; he may also be a feeder. He must, therefore, be equipped for crop and animal husbandry, and, to be successful he must be proficient in both arts of farming. His system, his mental stock-in-trade, and his equipment on the farm all bear the same hall-mark, and the hall-mark above all others of value to the nation, to wit, FLEXIBILITY.

"The ley to the ley-farmer has two equally important functions to perform—the sward, or animal ration function, and the sod, or soil fertility function." The best practice, founded on scientific principles, would be to employ one- or two-year leys for hay and four to six years for grazing only.

Straw as a Soil Improver

An informal discussion was held at Rothamsted on July 15 on the subject of the use of straw as a soil improver. The question has come into prominence recently in connexion with systems of farming based on mechanized cereal production with little or no live stock, and the purpose of the meeting was to put on record a statement of the position from the scientific and the practical sides. Some of the points made in the course of the discussion are collected below. The conditions favourable to the rotting of straw in the heap are: sufficient moisture, a supply of available nitrogen, presence of air, a neutral or slight alkaline reaction. It is probable that the same changes occur when straw rots in the soil as in the heap but they take place more slowly. Nitrate is not an ideal source of nitrogen for the rotting of straw as some loss of gaseous nitrogen takes place. This loss may occur when straw rots in the presence of soil nitrate.

Elaborate field experiments on the fertilizing effect of straw have been carried out at Rothamsted in recent years. It has been shown that unrotted straw used alone has a depressing action on the following crop, consequently the experiments test straw plus a supplementary dressing of artificials. Used in this way, straw with artificials has done as well up to the present as farmyard manure, when the effects are followed through five successive crops. The Rothamsted soil is excellently suited to artificial fertilizers, and in these experiments dressings of artificials applied to each crop grown have done rather better than either dung or straw. On the light land at Woburn the results of adding straw without artificials have been bad, but when used with green manures the effect has been more promising.

Farmers who have themselves been testing different methods of straw disposal appear to be giving up burning in favour of return of organic matter to the soil. The depression following the turning under of raw straw was widely recognized, and almost all speakers either applied a dose of nitrogen to the straw before ploughing under or gave a generous application of nitrogenous manure to the following crop. Where bare fallow followed corn all the straw could be ploughed under without detrimental effects and the straw disappeared before the next crop came round. The combine does not spread the straw uniformly and there is difficulty in turning it under, especially when it is supported on a high stubble. Disc

ploughs will bury it, but they work best when the ground is just sufficiently solid to enable the discs to cut the straw. It was agreed that the heavy wads of straw sometimes turned in were harmful to crops, but the cause of this was disputed, some thinking it was due to looseness, others to nitrogen shortage.

An entirely different aspect of straw disposal was discussed in relation to glasshouse soils. Here there is continuous cropping under the most intensive conditions. Heavy dressings of dung and enormous amounts of artificials are applied, and there is copious surface watering. Under these conditions, soils, although rich in plant food, become " sick," and, among other remedies, the incorporation of straw brings about substantial improvement in aeration, drainage and root action.

The problem of straw disposal arises chiefly on farms that are cropped with cereals more frequently than was usual under the old rotations, and in these circumstances certain fungal diseases have become increasingly troublesome. Two of these were dealt with in the discussion. Take-All in wheat is probably the worst pest that mechanized farmers have to deal with, especially on well-aerated alkaline soils. The disease persists in infected roots and stubble, which, when ploughed under, convey the infection to the roots of the succeeding crop of wheat or barley. The aim should be to accelerate the decomposition of the fungus in this infected plant material so that the pest will have been destroyed before the land is again drilled with a susceptible crop. Infected stubbles should be ploughed under at the first opportunity in early autumn, and there is reason to believe that the ploughing in of additional straw will favour the decomposition of the fungus provided that the nitrogen, which is desirable on other grounds, is withheld until the spring. It appears that the presence of nitrogen to some extent protects the fungus from decomposition. Since the severity of the Take-All attack is increased by good soil aeration the presence of unrotted straw in the soil is probably a bad feature. It remains to be determined whether on the balance the ploughing in of straw is detrimental or beneficial.

The other disease only recently recognized in this country is caused by *Cercosporella herpotrichoides*. It is one of the causes of lodging in wheat and winter barley, since the fungus weakens the base of the stems in its later stages. It occurs

most frequently on well nourished, rather heavy soils. Like Take-All it survives in the stubble and attacks the young crop next spring. A good supply of nitrogen, wet conditions, and heavy seeding all favour the disease. Methods of control are as yet not thoroughly worked out, but measures taken to cope with Take-All are likely to apply to this disease also.

On the agricultural side, the discussion showed one pressing need, namely, to take the subject out of the area of observation, and institute a wider series of field experiments that can give quantitative answers to some of the main questions involved.

Women's Farm and Garden Association

The following Note has been contributed by Miss A. Vanderpant, the Secretary of the Association:—

Among pioneer efforts for equipping and training women for recognized professional work, the society now known as the Women's Farm and Garden Association deserves honourable mention. Founded in 1899 as the Women's Agricultural and Horticultural International Union at a time when opportunities for women in agriculture and horticulture were much less numerous than they are to-day and when public opinion in regard to women's work on the land in what may be called a professional capacity was to some extent apathetic and perhaps a little critical, the Union did valuable work in providing a focus to which scattered units could be gathered together, and in setting up a kind of organization to look after the interests of women agricultural workers. The needs of the situation and the temper of the time can clearly be read in the declared objects of the Union which were expressed in the following four heads, and which it is of interest to note have remained unaltered to the present time:—

1. To unite all professional women workers in Agriculture, Horticulture and allied subjects, and those interested in such work for women, into a strong central association
2. To help and advise women in all matters connected with these professions.
3. To further the interests of women by seeking their due representation on public bodies concerned with matters relating to Agriculture and Horticulture.
4. To watch events and to make representation to public bodies on matters relating to Agriculture and Horticulture, especially with regard to those affecting the interests of women.

The advent of the War in 1914 gave the Union an opportunity for important service and placed on its shoulders a degree of responsibility which probably its promoters had

never dreamed of. Under the title of the Women's Farm and Garden Union which it adopted in 1915, the Union started short training courses for educated women on farms that were lent for the purpose and the "war branch" of the Union organized the Women's National Land Service Corps. This work, which was assisted by the Government, was very successful and it soon became recognized by farmers that women who had received such training as the Union provided could be of service in farming. Indeed, the demand for such women became greater than could adequately be met by a voluntary organization. The Board of Agriculture was approached with the result that the Women's Land Army was established early in 1917. The Land Service Corps, however, continued in being, co-operating with the Women's Land Army in many directions, organizing seasonal workers and undertaking a variety of duties that need not here be specified. Altogether over 9,000 workers passed through the hands of the Land Service Corps. After these heroic efforts, the post-war activities of the Women's Farm and Garden Association —which was now its formal title—must inevitably seem small and modest in comparison. Largely through the assistance of generous donations the Association was, however, placed in a position to participate in a small way in the movement for land settlement, which made so strong an appeal just after the War. An estate in Surrey was acquired and divided up into small holdings, so as to enable women with experience to start on their own on agricultural holdings with security of tenure. All but one of these holdings have now been purchased by the tenants. For the most part, however, the activities of the Association are concerned with placing suitably qualified women in agricultural employment. Horticulture provides the most numerous openings and in recent years the Association has been able to place annually between 60 and 80 of its members. These posts include head gardeners in private and institutional gardens, assistants with commercial firms (fruit growing, market-gardening, etc.), instructors and teachers in schools and training colleges, landscape gardeners' assistants, florists' assistants, etc. Posts connected with farm, dairy and poultry work in which members of the Association have been placed include farm bailiffs, dairy managers, stockwomen, poultry managers, dairy factory supervisors and assistants on dairy and poultry farms, etc. Taking these posts together the total number filled by the Association in the last

few years averages about the same as the number of horticultural posts. The membership of the Association, which is now approximately 900, thus embraces women in a great variety of different employments, e.g., some working on their own, others in public appointments, others in managerial positions or working as assistants. The social side is provided for at the Headquarters of the Association, Courtauld House, Byng Place, W.C.1, where a hostel is run on club lines and members are kept in touch with the Association by means of a quarterly magazine. A development in the same direction is now under consideration for forming county groups to enable members to meet and discuss subjects of common interest.

It remains to record that in 1929 the chief training centres (Departments of Agriculture at universities, agricultural colleges and farm institutes) became affiliated to the Association, and are represented on the Association's Council of management. This year the Association was able to offer a small grant for an initial or an additional training. Judging by the number and type of candidates who sent in applications, financial considerations are a great hindrance to women wishing to train, and if the Association's experience in this respect is a general one, it would appear that the number of scholarships at present available for agricultural students is hardly adequate to meet the demand.

Birds in Suburban Gardens

In these days, when large tracts of country with good natural cover are being cut up for building and other purposes, certain species of birds find it increasingly difficult to secure suitable nesting sites, with the result that they are coming into suburban gardens in greater numbers than ever before. Many of these are beneficial species, and the suburban bird-lover has an opportunity, not only of studying their habits, but, by means of nest-boxes, bird tables, baths, etc., of keeping them in his garden to both his own and the birds' advantage.

Foremost among such birds are the tit family, all of which, with the exception of the long-tailed tit, nest in holes or cavities of some kind. Tits are very ready to accept artificial nest boxes. It is probable that they are also the most seriously affected by the destruction of old hollow trees, stumps, and old buildings, in which they normally nest. As a rule, modern buildings offer little scope for them, and the bird lover can do much good by providing nesting facilities in his garden.

It may be asked—why introduce the subject of nest boxes at this time of the year, when the nesting season is long past and breeding will not begin again until next spring? The reasons are two. First, if nest boxes are put up in the autumn the birds will, by next spring, have had ample time to become used to their presence. Secondly, the winter will tone down the newness of the boxes, which will acquire a weathered appearance and will thus look more natural.

Nest boxes are easy and inexpensive to make, but care should be taken to see that they are properly designed, weather-proof, and suitably placed. The Ministry of Agriculture's Leaflet No. 212, "Nest Boxes for Birds," gives all necessary information and can be obtained from H.M. Stationery Office, York House, Kingsway, London, W.C.2, price 1*d*. net per copy or 9*d*. net per dozen copies (postage ½*d*. each or 1*d*. per dozen).

Bird-feeding tables, also, are quite easy to make, and although they cost a little more than nest boxes, are within the reach of the average suburban dweller's purse. The simplest form of bird-table is a mere platform fixed on the top of a wooden pole. More elaborate models have gabled roofs to keep off the rain, doors, windows, and other refinements. Most of these are unnecessary, although it is wise to have a roof of some kind. Any style of bird-table can be made by anybody with a slight knowledge of carpentry. In spring and summer, bird-tables are unnecessary, and, indeed, undesirable, since at these seasons the birds can obtain plenty of natural food; but in late autumn and winter, particularly in hard weather, they are a boon to many birds and may well result in saving some of them from starvation. On every bird table there should be an adequate supply of drinking water. During prolonged spells of hard weather this is even more important than food.

The food platform of a bird table should be not less than four or five feet from the ground. The table itself should stand in the open, with a clear space all round, so as to give the birds a chance of seeing approaching cats or other enemies. As to food, bread, biscuit, and household scraps of various kinds are all suitable. Strings of peanuts are very popular with tits, as also is suet. This should be melted and run into the half of a coconut shell or some similar receptacle, suspended upside down. It is not advisable to offer coconut kernel, as there is good reason to believe that this food is bad for tits.

Bird baths can be made of cement or bricks, or, if preferred, can be bought from firms specializing in garden furniture. These baths are usually made from stone, natural or artificial. All bird baths should be kept constantly filled with clean water, and should not have a greater depth than two inches. As with feeding tables, they should be put out in the open with ample space around them.

Among the birds that may be expected to use nest boxes are the great tit, the blue tit, the coal tit, the robin, the pied wagtail, and the spotted flycatcher—all beneficial species. One of the greatest advantages of nest boxes is that by their means the bird population of gardens can to some extent be controlled. Entrance holes of a convenient size for tits will be too small to admit other birds, so that house-sparrows and other undesirables can be excluded. The special, open types of nest boxes necessary for such birds as robins, wagtails and flycatchers, are usually placed too low for sparrows.

Any bird that is likely to visit a suburban garden is almost equally likely to use a feeding table, provided that suitable food is offered. Even comparative rarities such as the greater spotted woodpecker, the lesser spotted woodpecker, and the nuthatch, have been known to frequent suburban gardens. Baths, also, will be used by many different species.

Most people are fond of birds, and it is pleasing to note that of late years the public interest in their welfare has greatly increased. By the methods outlined above, owners of suburban gardens, although lacking the wider opportunities of those living in rural surroundings, can do much to help birds, and, in the process, find material for pleasant and profitable study.

Auto-Sex-Linked Breeds of Poultry

Research work has been in progress at Cambridge for some years past on new breeds of poultry of which the sexes of the day old chicks can be distinguished at hatching by the pattern and shade of the down-markings. The distinction is clear, constant and fool-proof. Ordinary sex-linkage involves crossing and consequently mongrel offspring. With auto-sex-linkage the sex distinction is within a pure breed; the characteristic continues generation after generation. A limited number of stock birds of these new breeds is now available for distribution. The Cambar is in two varieties, gold and silver. It is a medium-sized, close-feathered, compact laying

type of bird, having white skin and shanks. The more recent Legbar, or Barred Brown Leghorn, is, as its name implies, of the Leghorn type. It is available either in yellow skin and shanks (like the ordinary Brown Leghorn) or with white skin and shanks. Interested breeders who would like to purchase stock should apply in writing to Mr. M. S. Pease, School of Agriculture, Cambridge.

Progress of the Land Fertility Scheme

The number of applications for contributions under the Land Fertility Scheme received from occupiers of agricultural land in the United Kingdom now exceeds 226,000. The quantities of lime and basic slag in respect of which these applications have been made are approximately 1,417,000 tons of lime and 436,000 tons of basic slag.

THE IMPORTANCE OF MASTITIS TO THE DAIRY FARMER

J. G. Davis,

National Institute for Research in Dairying, Shinfield, Reading

Mastitis—its Definition. The term mastitis means literally "inflammation of the breast or udder." Many other names are used to indicate this condition in cattle, including *mammitis*, "garget," "weed," "chill in the udder," "sore udder," "felon quarter" and "bad quarter." Although mastitis, strictly speaking, includes all inflammatory conditions of the udder, the term nowadays generally implies the bacterial invasion of the udder by *streptococci*. In some instances the condition is obvious to the milker (acute type) but the most common form is often not suspected by the casual observer. A high proportion of cows harbouring the organism responsible for this chronic type of mastitis may remain for long periods and even throughout one or more lactations in the sub-clinical condition, i.e., there are no obvious signs of the disease. It is most important that this fact should be realized by the farmer. For example, clinical examination can only detect about 10 per cent. of infected cows, and even the use of indirect tests, such as the brom cresol purple paper test, may not detect more than 50 per cent. of cows suffering from mastitis. Moreover, some indirect tests are unsuitable for cows in late lactation and may also give 10 per cent. or more false positives for cows in full milk. It is unfortunate that this sub-clinical type of mastitis is contagious. Infected cows, therefore, constitute a constant source of danger to those animals which have not succumbed to the disease. It is only by means of a bacteriological examination that the presence or absence of mastitis can be definitely established. The incidence of the disease has been estimated to vary from 10 to 80 per cent., the average probably being about 40 per cent.

Effect on Milk Yield. As the result of the invasion of the udder by the pathogenic bacteria causing mastitis, the milk-secreting cells are damaged or destroyed, the extent depending upon the degree of infection and the type of organism responsible for the mastitis. It is not surprising, therefore, that the milk yield is lowered. The average fall in yield has been estimated to be about 15 per cent. Milk records, when properly used, may provide a valuable pointer to the presence of mastitis, e.g., a sudden drop in yield otherwise unaccounted for may indicate the onset of an attack. Where milk recording

is not practised, this information will not be available and the presence of mastitis may not be suspected. Any sudden fluctuation in yield should be followed up at once by further examination. The annual loss of milk due to mastitis which, although affecting their cows, is unsuspected by farmers, is undoubtedly heavy, probably amounting to £2,000,000 or £3,000,000 annually over the country as a whole. In addition, mastitis brings about further losses due to faults in cheese and other milk products.

Effect on Milk Quality. The quality or chemical composition of milk is adversely affected by mastitis, the extent varying with the severity of the disease. The most marked change is a fall in the lactose (or milk sugar) and a rise in the chloride (or salt). In addition, milk from a diseased quarter is frequently more alkaline than normal milk and so turns brom cresol purple paper a purplish colour. Further, it has a low calcium content and, as a result of its low acidity (i.e., high alkalinity) and low calcium, clots less easily with rennet. Mastitis milk has usually considerably less nutritive value, gallon for gallon, than normal milk.

Effect on Bacterial Quality. It has been found that the bacterial content of milk taken under clean conditions from a healthy, mastitis-free cow is very low, nearly always less than 500 per ml. (28 ml. = 1 oz.) and very rarely greater than 2,000. Milk from a cow suffering from mastitis usually contains much greater numbers of bacteria, not only those causing the mastitis, but also other types, usually cocci, which may be regarded as secondary invaders and which are likely to cause taints and lower the keeping-quality of the milk. As an example the following figures may be quoted:—

TABLE I

(DAVIS and MCCLEMONT)

	Mastitis-free Cows	Mastitis-infected Cows
Bacterial Count on Milk Agar (37°C.)	No. of Samples *	
Less than 500	243	97
500–2,000	9	22
Over 2,000	0	51

* Age of samples at testing about 3 hours.

It will be seen that, whereas practically all the samples from mastitis-free cows had a count of less than 500, 30 per cent. of the samples from infected udders had a count of over 2,000. Such infection would only be detectable with certainty by a bacteriological examination. It is frequently stated that the milk from young cows contains fewer bacteria than that from older animals. The latter are, however, more liable to mastitis and it has been found that this increased count in older cows is usually due to mastitis. Whereas roughly 25 per cent. of first calf heifers have mastitis, about 50 per cent. of cows with 3 or more calves suffer from this disease.

Effect on the Methylene Blue Test. Many apparently contradictory statements have been made concerning the effect of mastitis on the methylene blue test. As a rule, mastitis results in a shortening of the reduction time, i.e., in a lowering of the quality of the milk as measured by this test. Thus Davis and McClemont found that, of a large number of samples from individual cows examined, 23 per cent. of those from infected cows failed to pass a certain standard, but only 5 per cent. of the samples from mastitis-free cows failed the same standard. Cases have been reported, however, where milk, badly infected with mastitis organisms, has given a satisfactory test with methylene blue. This may be because mastitis streptococci themselves cannot reduce methylene blue or do so with difficulty. The shorter reduction times usually found are brought about by the associated micro-organisms in the infected milk. Thus, milk containing many mastitis streptococci, but only very few other organisms may pass the methylene blue test with flying colours. The altered chemical quality of the milk may be another factor contributing to these freak results.

Mastitis as a Cause of Faults in Dairy Products. Mastitis has frequently been alleged to be the cause of faults in cheese, often without satisfactory evidence. It is unfortunate in this respect that the term "mastitis" is used rather loosely to include many types of disease and abnormalities of the udder. These abnormal milks may be responsible for slow starter, weak curd, poor texture and off taints and other faults due to bacterial contamination.

SLOW STARTER. This is still the most common fault in cheesemaking and its occurrence may not be realized by the cheesemaker in the milder cases. The time wasted in the

making process is not the only point to be considered, as a slow starter usually results in the retention of moisture and a weak curd, which themselves lead to a poor-textured cheese, colour faults and off-taints. The question as to whether mastitis is the cause of slow starter cannot be answered by a simple "yes" or "no," as this depends on the type and degree of infection and on the change in chemical composition of the milk. Experiments have shown that starter may grow either more slowly or more quickly in mastitis milk as compared with normal milk. It may be recommended, however, that on a cheesemaking farm where slow starter is experienced the milk of each cow in full lactation should be tested for slowness by a simple acid development test. For this purpose about a half-pint of the mid-milk from each quarter should be placed in small bottles which have been sterilized by immersion in boiling water for 5 minutes and then drained upside down. One per cent. starter is added, mixed well with a sterile spoon and kept at about 86°F. About 6-12 samples should be tested at the same time. Clotting should take place in 12-18 hours, although these times will naturally vary with conditions. Bad samples of milk will readily be detected by a prolonged clotting time. A shorter clotting time probably indicates a contaminated udder and the likelihood of bacterial taints. Therefore, all milk which is clotted in either a very short or a very long time should be excluded from the cheese vat.

WEAK CURD. Mastitis milk, on account of its low casein, calcium and acidity, tends to produce a weak curd, and it is impossible to make first-class cheese unless the milk is normal in these factors.

OFF TAINTS. Milk from infected udders is frequently rich in bacteria, many of which attack the protein of milk to produce foul smelling substances. Taints of this nature will be enhanced if slow starter is encountered owing to the weak acidities and low moisture content. Faults may thus reinforce one another.

COLOUR FAULTS. Most colour faults in cheesemaking are due to bacteria which require oxygen. Slow starter results in high moisture and poor texture and leads ultimately to cracking and the entrance of air, thus permitting the colour-forming organisms to grow. The interior of a good cheese contains too little oxygen to allow such types to flourish.

PUBLIC HEALTH ASPECTS. Fortunately, the common mastitis organisms are not usually pathogenic for human

beings. Nevertheless, where mastitis milk has large numbers of staphylococci (secondary invaders) it may also contain substances capable of causing severe illness in human beings.

Detection of Mastitis. Numerous tests for the detection of mastitis are known. They consist of:—

1. Bacteriological plating methods
2. Clinical and other indirect tests.
3. Chemical analytical tests.

Bacteriological plating of individual quarter samples carried out at least twice is the only really satisfactory test. It can only be done by a veterinary surgeon or bacteriologist experienced in this particular work. Examination of bulk milk will detect only gross infection. There are, however, a number of simple indirect tests which will detect the worst cases or at least give an indication of the percentage infection of the herd. These simple tests can easily be carried out by the milker and should be done on individual quarter samples at least once a fortnight.

BROM CRESOL PURPLE TEST. This test paper may be bought from chemists or may be prepared by soaking filter paper in the saturated dye solution. Hold four strips of brom cresol purple paper fanwise between the finger and thumb of the left hand and let the milk from each quarter in turn fall upon a piece. If at the end of about 5 seconds any of the pieces is purplish in colour, mastitis is probably present. The test is not suitable for cows in late lactation. These may also give a positive test, although the colour in this case tends to be a strong navy blue rather than a purple and is usually found in all four quarters. The point to look for in a test of this kind is a difference between one or more quarters and the others. The eye soon becomes familiar with the normal colour, which may be described as a dove grey. Papers should not be examined in direct sunlight and care should be taken that the ammonia from stale urine in the cowshed does not turn the test paper purple.

STRIP CUP AND DISH TESTS. Draw a little fore milk on to a black sieve in a pot or into a shallow black dish. If fine flakes or clots are present the cow is probably suffering from mastitis and a positive brom cresol purple *and* strip cup test may safely be taken as evidence of mastitis. Disinfectant should be added to the strip cup after use and the milk put down the drain.

INDURATION OR HARDENING OF THE UDDER. It is sometimes possible to detect mastitis by a careful hand examination of the udder of a freshly milked cow. The presence of any hardened tissue probably indicates mastitis.

Eradication. In the absence of a certain curative method the only practicable method at present is to separate and dispose of the infected cows.

PRECAUTIONS TO BE OBSERVED BY THE OWNER. (1) If possible, the owner should have all cows in milk tested by bacteriological plating. The milk from each quarter should be tested at least twice at intervals of not less than a week during each lactation and preferably not before three weeks after calving. Diagnosis by the indirect tests is less satisfactory, but if it is impossible to have the herd tested bacteriologically a great deal may be accomplished by the systematic use of these simple tests. Before disposing of a valuable cow, however, the milk should be tested bacteriologically.

(2) The second step is the separation of all positive and suspected cows from the mastitis-free animals. *All bad cases, i.e., those animals continually excreting large numbers of mastitis organisms, should be disposed of immediately.* By far the best method is to form two separate herds having separate sheds, utensils and milkers. This is, however, often impracticable and, if so, the infected cows should be placed in separate standings at one end or in one row of the shed. These should have their own milkers and utensils.

(3) In both clean and infected herds the animals should be arranged in order of number of calves so that the heifers are milked first and the oldest cows last.

(4) All animals should be tested every lactation and the simplest way of ensuring this is to have the herd tested every six months.

(5) Good herd management is essential, especially in regard to milking, e.g., regular milking, efficient stripping and avoidance of over-stocking.

(6) All incoming heifers and cows should be tested and only those animals giving a negative result on two tests accepted.

PRECAUTIONS TO BE OBSERVED BY THE MILKERS.

(1) Cows should be milked in order of age, i.e., heifers first and oldest cows last.

(2) Hands should be washed before milking each cow.

(3) Udders should be washed down in a weak disinfectant, e.g., diluted Chloros at a strength of 5 parts chlorine per million.

(4) Milkers handling infected cows should not milk mastitis-free animals.

(5) In general, the directions laid down in *Modern Milk Production* (Ministry of Agriculture Bulletin No. 52)* should be observed.

General Observations. If cows are tested regularly over a period, it will be found that a few appear to recover from the disease, i.e., mastitis organisms can no longer be recovered from their milk. It is, however, dangerous to transfer such animals to a mastitis-free herd as recovery is seldom really complete. Some infection may be very slight and the effect on milk quality barely detectable, so that it may be doubted whether the condition can be termed "mastitis" in the ordinary practical sense of the word. Nevertheless, any animal excreting mastitis organisms in its milk is a potential source of infection and in any eradication scheme must be regarded as a positive. Animals not severely infected and which are otherwise in good health and give a high yield of apparently good quality milk may be kept in the "positive" herd until a convenient opportunity for their disposal occurs. It it obviously not practicable to dispose of all positive cases at once.

No certain method of curing mastitis is known. Reports have been made of the successful use of various antiseptics, dyes and other trade preparations. Farmers interested in such treatments should consult their veterinary surgeons.

The economic importance of mastitis to the dairy farmer is undoubtedly comparable with that of tuberculosis and contagious abortion, although its effects may not be so evident to the eye, and a national scheme for its reduction to insignificant proportions is highly desirable.

This article has been written by a bacteriologist who is not a veterinary surgeon, with the object of emphasizing the economic aspects of mastitis. The information contained in it may therefore be regarded as complementary to the advice which the farmer will receive from his veterinary surgeon.

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* Obtainable through a bookseller or from H.M. Stationery Office. Price 9d. (by post 11d.)

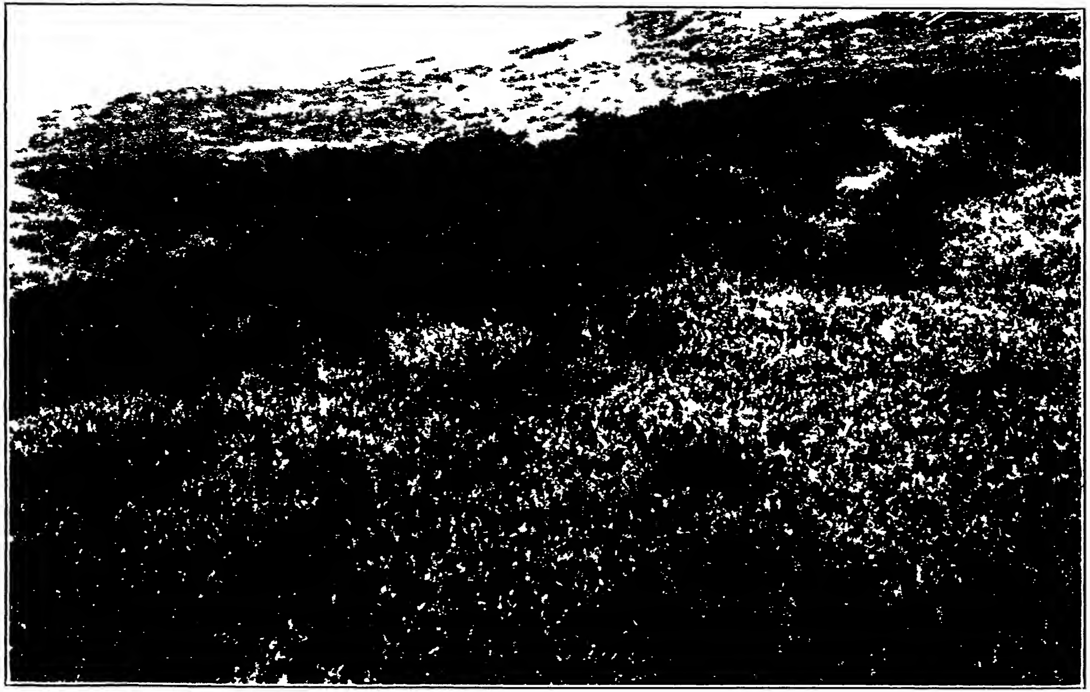
THE BLAEBERRY

BRYNMOR THOMAS, M.Sc., A.I.C.,
AND
H. W. DOUGALL, B.Sc.,
King's College, Newcastle-upon-Tyne

The Blaeberry (*Vaccinium Myrtillus* Linn.) is a small, glabrous shrub, 6-18 in. high, with a woody, creeping rootstock which sends up numerous erect, angular, green stems. The leaves are deciduous, ovate, often slightly cordate at the base and have toothed edges. Their texture might give the impression that they are evergreen, but they fall before winter, turning red in autumn. The flowers, which are nearly globular and of a pale greenish-white colour, appear from the end of March to the beginning of June and grow singly in the axils of the leaves. The fruit, which ripens in July and August, is globular with a flat top; it is black but appears to be blue owing to a coating of wax. Alternative names for the fruit are whortleberry and bilberry. It may be observed that the plant does not fruit when overshadowed by trees, or on ground which is very heavily stocked with sheep.

According to Bentham and Hooker,[1]* the blaeberry is found in mountain heaths and woods in northern and central Europe, Russia and Asia, but is restricted to great mountain ranges in southern Europe. It is common in Britain, except in the eastern counties (Cambridgeshire and Suffolk). Blaeberry is usually found at some elevation, and is a calcifuge. It is stated by Step[2] that there are places in the chalk downs where the plant grows in profusion, but in such cases it will be found that the chalk is overlaid by deep beds of sand in which the blaeberry is actually growing side by side with heather and foxgloves. In the north it is usually found on peat, and thrives best on the higher parts of black land, where it may be one of the most formidable competitors of heather. Where heather has been burned too frequently, or otherwise mismanaged, blaeberry may claim equal rights with it, or even displace it completely. Wallace[3] has asserted that the burning of heather which is engaged in a fight for existence against blaeberry inflicts a further handicap on the former, as the blaeberry roots are not destroyed and stools are sent up in the first season. The same

* For references see page 552.



Fi 1 Bla berry with common heather on black land in Northumberland

I II p 54

FIG. 2. Isolated plants of Blackberry showing the strong rooting habit

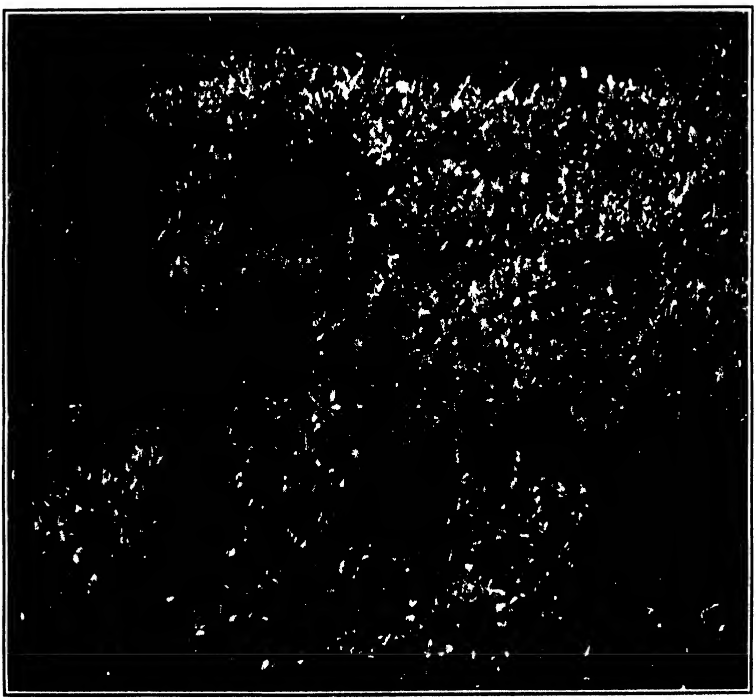


FIG. 3.—Detail of Blackberry growing among heather

authority has stated that where sheep lie at night and leave their droppings, blaeberry will often displace heather, for the latter, while it will grow luxuriantly in a good garden soil which has not been recently dunged, is injured, if not exterminated, by manures applied to improve hill pasture.

In discussing the effect on heather of too frequent burning, Stapledon[4] has said that, in consequence of such ill-management, "the heather will always be stunted and dominance will be shared with plants like crowberry and bilberry, of little use as pasturage and of no great benefit to grouse." If this dictum be accepted, then there is nothing more to be said about *Vaccinium Myrtillus*. In fact, however, all other competent authorities are in complete agreement concerning the substantial value of blaeberry as a food for grouse, and there is a considerable body of opinion which holds that the plant, where present, is largely eaten by hill sheep.

In the Final Report of the Committee of Enquiry on Grouse Disease,[5] Wilson and Leslie state that, of all substitutes for heather, blaeberry is undoubtedly the most valuable. Grouse eat the buds, leaves and berries with avidity, and even the caterpillars that infest the plant in early summer are a source of food supply for the young birds. The consumption of blaeberry is somewhat irregular, and appears to depend on the extent to which it occurs, and on the general supply of food, rather than on any tendency of the birds to eat more of the plant in one month than in another. It is shown in the above Report that blaeberry forms 30 per cent. of all the foods consumed by grouse in Derbyshire; 22 per cent. in Yorkshire, and 11 per cent. in some of the counties of Scotland. The Report continues that, "In special cases these averages are departed from, especially when the heather crop has been a failure. Thus some December specimens from Lancashire showed the remarkable average of 80 per cent. of blaeberry stalks and buds, with only 17½ per cent. of heather shoots and 2½ per cent. of heather seed, but in this instance the heather-seed crop in Lancashire was reported as very bad. In the same year the heather-seed crop in Peebles and Merioneth was reported as exceptionally good, and the December specimens from both these counties showed the proportion of 50 per cent. of heather shoots and 50 per cent. of heather seed, but *no* blaeberry." Further evidence as to the value of blaeberry as a food for the moorland game birds is provided by Scott,[6] who states that when the plant is in fruit

grouse gather on the ground in large numbers, coming from considerable distances.

Practical opinion concerning the value of blaeberry as a food for sheep is not unanimous, but it is very seldom that a shepherd will assert with conviction that the plant is never eaten and is useless as fodder. A majority of hill men believe that blaeberry, where it occurs, is a useful component of the moorland sward. That the extent to which blaeberry is eaten will be determined by the circumstances of each particular case is suggested by a communication which the writers have recently received from a Cumbrian farmer[7] who states that " in a normal season, and on grazings of this nature, blaeberry is not eaten by sheep. Ordinarily there is plenty of grass available by the time the budding or young leafy stage is reached. During very dry periods such as the present, the leaves have been eaten. Where the area of blaeberry is extensive and where grass is scarce, the former may constitute a larger part of the diet." Such an authority as Wallace[8] appears to be in no doubt of the usefulness of the plant, for he states that " It is also, in certain districts in which sheep eat it, a valuable food for sheep, especially in spring and early summer, when the young leaves are coming."

The excellent culinary qualities of the berry are well known, and it is stated by Step[2] that the juice has been much used in the dying of wool and is reputed to be used for colouring wines. It may be of interest to note that, in the United States of America, a number of attempts have been made to bring the blaeberry into cultivation, and that success appears to have been eventually achieved.[9] Much attention has been given to the breeding of hybrids capable of producing large yields of high quality fruit for market. Propagation is by cuttings, and the bushes are said to come into bearing when three years old, and to yield heavily at four.

A series of samples was obtained during 1937 from high-lying ground at Smale, in the valley of the North Tyne, recently planted with conifers by the Forestry Commission. The first sample was taken on May 3, and others at monthly intervals thereafter until September. A winter sample was obtained in January, 1938. The bottom growth in the Smale forest consists largely of flying bent (*Molinia coerulea*) and common heather (*Calluna vulgaris*), with some deer hair (*Scirpus caespitosus*) and occasional large patches of blaeberry. The young trees have not yet made sufficient growth

to exercise any considerable effect on the character of the ground covering. A sufficient indication of the soil conditions is given by the profile description and analytical data given below.

TABLE I

PROFILE DESCRIPTION

LOCALITY	Stannersburn, North Tyne, Northumberland.
SITE	Slope (15°) at 970 ft above sea level.
VEGETATION	Sitka Spruce, Scots Pine, Norway Spruce and Larch with *Molinia cærulea, Calluna vulgaris, Vaccinium Myrtillus, Scirpus cæspitosus*
PARENT MATERIAL	Boulder clay over Carboniferous Limestone.
A_0 0–5 cm	Mat of chocolate brown leaf litter. Loose and undecomposed. Moist
A_1 5–12 5 cm	Black, well-decomposed organic material. Fairly loose Many roots present. Moist.
A_2 12·5–27·5 cm.	Greyish brown sandy loam Fairly compact. Moist
B_1 27·5–58 cm	Blue clay with yellow mottling and pockets of sand Roots present, and a few stones. Compact. Moist
C 58 cm. +	Blue boulder clay with pockets of organic matter. A few large stones present Very compact. Very moist

ANALYTICAL DATA EXPRESSED AS PER CENT OF AIR-DRY SAMPLE

HORIZON	A_1	A_2	B_1	C
LOSS ON IGNITION	94·01	9·69	7·38	7·97
COARSE SAND	—	21·56	13·32	9 23
FINE SAND	—	51·83	44·8	33·97
SILT	—	10·3	13·35	16 02
CLAY	—	11·3	27·25	33·35
$CaCO_3$	—	0·009	0·005	0·019
EXCHANGEABLE Ca	—	0·032	0·02	0·064
pH	4 11	4·39	4·63	5·2
P_2O_5, HCl-SOLUBLE	0 2566	0·096	0 0142	0·0095
K_2O, HCl-SOLUBLE	0·1232	0 0943	0·2719	0·3663
P_2O_5, AVAILABLE	0·0163	0·0061	0·0026	0·0001
K_2O, AVAILABLE	0 034	0·0088	0·0044	0·0109

It is not suggested that blaeberry is confined to soils such as that described above, indeed there is evidence that the plant can flourish under widely varying soil conditions. It will be noted, however, that in the present instance the soil shows that high degree of acidity which is generally considered necessary for the growth of blaeberry.

Samples were taken at random on an area of approximately 30 yds. by 10 yds., the stems being severed close to the ground by means of a sharp knife. After conveyance to the laboratory, the leaf was separated from the stem, and the latter

discarded. It should be noted that the sample taken in January, 1938, consisted only of stem and bud, and that it was dried and milled in its entirety. The usual analytical methods were employed in the examination of samples.

The digestibility of the crude protein as determined in vitro should be accepted with some reserve; the digestibility coefficients found do not seem to present any unusual feature, but it is the experience of the authors that the method of Wedemeyer is unreliable when applied to such ericaceous plants as common heather and bell heather. The analytical results obtained are tabulated below.

TABLE II—PER CENT. OF DRY MATTER

Sampling Date	May 18	June 29	Aug 13	Aug 20 (Berries)	Sept 28 1937	Jan 10, 1938
*CRUDE PROTEIN	18·58	13·49	11·61	9·66	10·14	7·17
ETHER EXTRACT	2·27	3·19	3·39	7·23	4·11	1·77
N-FREE EXTRACTIVES	64·64	63·59	62·26	67·38	62·66	49·92
FIBRE	9·89	16·04	17·7	12·84	17·2	8·75
†ASH	4·64	3·69	5·04	2·89	5·89	2·39
*Including TRUE PROTEIN	17·44	12·24	11·06	7·41	9·63	6·62
†Including PHOSPHORIC ACID (P_2O_5)	0·557	0·532	0·514	0·502	0·419	0·343
LIME (CaO)	0·997	1·067	1·326	0·352	1·839	0·757
SILICA	0·399	0·109	0·139	0·196	0·337	0·065
PERCENTAGE DIGESTIBILITY OF CRUDE PROTEIN (Wedemeyer)	81·57	31·58	30·92	40·16	37·57	44·7

As judged on the results of chemical analysis, the sample obtained on May 18 is of exceedingly high nutritive value. The percentages of crude and digestible protein, and of lime present are such as one would expect to find in a sample of young grass from a first-class pasture. At the same time, the phosphoric acid content is reasonably good, and the fibre extremely low. It should be admitted, however, that the amount of such material available at the time of sampling was relatively small.

During the period May 18—June 29 there would appear to have been a sharp decline in the feeding value of the foliage, but from the latter date until the end of September deterioration, although progressive, was not particularly marked. This change is chiefly evident in a declining protein content, and an increase in fibre. As might have been anticipated, the

phosphoric acid falls in sympathy with the crude protein, but to a much less marked degree. On the other hand, the lime content rises as the season advances so that in the sample of September 28 there is almost 100 per cent. more than in the earliest spring foliage. It is obvious that the ash of blaeberry is ill-balanced in respect of lime and phosphoric acid at all times, but that neither of the foregoing mineral constituents shows the very marked deficiencies which are so evident in many of the commoner moorland plants. The phosphoric acid content, while it may be low relative to the lime, is substantially higher than in members of the Ericaceae so far examined, and is probably higher than in most non-ericaceous moorland plants, whether belonging to the Gramineae, Juncaceae or Cyperaceae.

The readiness with which the berry is consumed by grouse is probably due to its palatability and succulence, although there may be some other factor or factors which the ordinary analytical technique is insufficiently refined to disclose. The data given in Table II do not suggest that it is of particularly high nutritive value; the crude protein content is rather lower than in the foliage, and the lime relatively very low. On the other hand, the berry contains respectable amounts of phosphoric acid and little fibre. The exceptionally high ether extract content is interesting, but no opinion as to the nutritional significance of this constituent can be offered.

It has already been indicated that the blaeberry is deciduous, so that the sample taken on January 10, 1938, consisted only of stem and bud. As the buds constituted only a very small proportion of the whole, it was anticipated that the sample would be decidedly fibrous. This has proved to be so, but it will be noted that the crude protein content is still approximately equal to that of winter heather at five or more years after burning. Furthermore, the Wedemeyer figures, although admittedly suspect, do suggest that the digestibility of the protein is not less than in midsummer and autumn. The proportions of phosphoric acid and lime present are lower than in earlier samples, but if good grass be excepted, blaeberry does not compare unfavourably in this respect, with most other forms of winter keep.

The evidence that blaeberry is largely eaten by grouse can be regarded as conclusive. There is little doubt that it figures in the diet of hill sheep, indeed its palatability seems to be such that intensive grazing and treading may lead to its sup-

pression. It would therefore be reasonable to assume that blaeberry has substantial feeding value, and the results of this investigation indicate that the assumption would be correct. As judged by its composition, the plant provides useful food at all times of the year—even in winter; its value in early summer is outstandingly high, and it is an unfortunate circumstance that the young blaeberry foliage makes its appearance simultaneously with the new season's growth of common heather. It has been shown, however, that the phosphoric acid content is higher than in most other moorland plants, whether ericaceous or otherwise, and it is possible that, like draw-moss (*Eriophorum vaginatum*), blaeberry provides some of the phosphate which heather lacks. The quantitative importance of the plants as a fodder is difficult to assess; in the northern counties of England at least, its distribution is erratic, and the total area of moorland which it covers cannot be considerable. There is little doubt, however, that where occurring in quantity it bulks largely in the diet of both grouse and sheep.

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PIG HOUSING

ROSSLYN COLAM

Believing that, by the elimination of solid partitions from a pig house, greater efficiency in ventilation would be obtained, a house was designed and constructed giving effect to this principle. The result has been very satisfactory and the following description of the house may therefore be of interest.

In designing a pig house the factors to be aimed at are:—

(1) Health of pigs.
(2) Reduction in labour.
(3) Cost of house per pig

To achieve (1) the design must provide for:—

(*a*) Frequent change of air without any suspicion of draught.
(*b*) Equable temperature.
(*c*) Reasonable amount of light
(*d*) Adequate drainage.
(*e*) Warm bed for the animals.

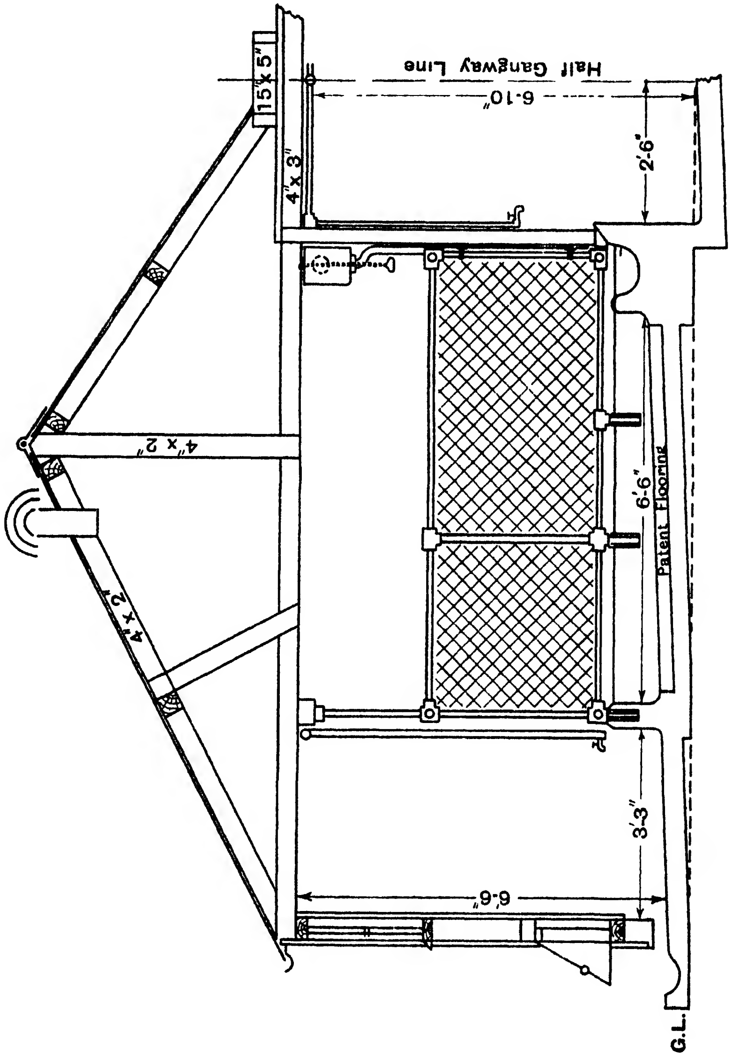
In order to obtain (2) there must be:—

(*f*) A proper dunging passage, with a supply of water for cleansing same
(*g*) A type of pen flooring which will not hold dung and bedding.
(*h*) Facilities for bringing the food in bulk to the troughs
(*i*) A quick and accurate method of watering the troughs if dry feeding is employed

To succeed with (3) the design must be such as will reduce the quantity of materials used to a minimum without impairing the efficiency of the house. All these points were taken into consideration when the house was built.

The double type of house was selected as this lowers the height of the roof, thereby reducing the cost. The centre gangway is 5 ft. wide to enable a pony and cart to bring the meal to the troughs through double doors at either end of the building. Concrete is used for all floors except the beds and for the dummy walls, which, on the outside walls, are only as high as the bottom of the ventilators. The outside walls are formed of wooden studs covered externally with corrugated asbestos sheets, and internally, from the dummy wall to the level of the top of the ventilators, with flat galvanized sheeting, and from this level to the eaves with one of the many insulating boards on the market. The roof is covered with corrugated asbestos sheets (flat ridge), taking the water into a wide asbestos gutter above the gangway. Metal windows are used, one being provided for each pen. If the extra cost can be

afforded, lining the roof with insulating boards would be advantageous, especially in the colder parts of the country.



The dividing partitions are all formed of 1-in. water tubing sliding into copper sleeves 6 in. long in the dummy walls, the cross tubing being kept in position by Ke-Klamp fittings,

which can be quickly adjusted or removed by using a set spanner. Chain fencing of 2-in. mesh is fastened to $\frac{3}{8}$-in. iron rods, which in turn are laced with wire to the tubes. The whole of the fittings could, if required, be removed from the building.

One ventilating opening, 3 ft. long by 14 in., is provided for each pen, with perforated zinc fitted in the opening to break the force of the wind. Two wooden doors are hinged at top to each ventilator and one or both of these can be kept open by means of the iron rod, resting in the wooden shoulders. Ashanco ventilators are used in the roof where indicated and the diameter of these must be calculated in relation to the size and number of ventilating openings and cubic contents of the house. It is suggested that the makers should be consulted before ordering. Water is laid on to the dunging passage by one tap to every four pens, and this facilitates cleaning operations. Taps are also provided in the gangway for washing down. The water from the troughs comes from an ordinary W.C. ball valve cistern, one being provided for each pen, and by adjusting the level of the ball valves the requisite amount of water per pen can be liberated by pulling the chain. In a large house, the time so saved in watering on top of the dry food is a considerable item.

This house was erected for pigs up to four months old, and the pens are 6½ ft. by 8 ft. The beds in this house were laid with patent hollow bricks, grooved on the surface to prevent the pigs from slipping. Whereas the beds have proved to be warm, they are extremely difficult to clean and the use of grooved flooring is not recommended.

It was decided after consulting experts, to seal the eaves and ridge with tow, in order to increase the efficiency of the ventilation, but this proved to be a mistake, as excessive condensation resulted. After the tow was removed all traces of condensation vanished and the ventilation was not interfered with. The house has proved to be practically free from smell, is warm, easy to work and the pigs do well in it, which is the main consideration. As to the cost, much must depend upon the situation and the method employed in building, and whether the house is to be used solely for pigs to five months or only for fattening, and may possibly vary from as much as £2 5*s*. 0*d*. to £3 per pig. The latter figure should not be exceeded where only fattening pigs are to be housed.

THE WORK OF THE ESSEX RIVERS CATCHMENT BOARD

The Essex Rivers Catchment Board was constituted as the result of the passing of the Land Drainage Act of 1930, and commenced operations in 1932. The Catchment Area extends over approximately 685,000 acres and covers the greater part of the County of Essex. It is bounded on the south by the River Thames and on the east by a seaboard broken by numerous tidal estuaries, small creeks and islands. As is probably well known, practically the whole of this coastline is fringed by marshes lying below the level of ordinary tides and protected therefrom by sea embankments. The area of these marshes rated for sea-defence purposes is approximately 73,000 acres, or 114 sq. miles. Much of this area, particularly along the north bank of the Thames, has been developed for industrial purposes, while other areas, such as Canvey Island, West Clacton, and Jaywick have been developed for residential purposes. The total length of tidal embankments and sea defences is 282 miles. While there are no really large rivers within the area, no fewer than 393 miles have been designated as "main" river, including lengths of the Colne, Blackwater, Chelmer, Crouch and tributaries, and several smaller brooks, such as the Holland Brook near Clacton, and the Mar Dyke, Ingrebourne and Beam which discharge into the Thames.

At the time of the formation of the Board, five drainage districts were in existence and in active operation in this area —Havering, Rainham, Fobbing, Canvey and Dengey. There were also eight other drainage districts which had become more or less moribund and in which no work was being done. By virtue of their powers under the 1930 Act, the Catchment Board took over from all those authorities their powers and duties in respect of sea embankments and as much of their main watercourses as had been designated "main river." The Catchment Board reconstituted these districts into Internal Drainage Districts and set up in addition two further Districts. Subsequently the Catchment Board successfully applied to the Minister for the transfer to them of the powers of the Internal Drainage Boards in all districts, except Canvey Island.

With the exception of the areas originally under Commissioners of Sewers on the Thames Side and in the Dengey area, the Board found that many parts of the works which they

had taken over had suffered from neglect. The rivers had become nobody's job, and were obstructed and overgrown, while the sea walls were under standard, often lacking in protective material and only maintained to the minimum strength that appeared necessary to each individual owner: urgent works were necessary to prevent the abandonment of the protected areas.

The first work of magnitude was undertaken by the Board in 1932, when about 200 men from local Labour Exchanges were employed for several months at Woodham Ferrers, raising and rebuilding by hand labour the sea walls around Clements Green Creek.

In 1934, as soon as the financial embargo imposed in 1931 was lifted, the Board embarked upon its first grant-aided scheme under Section 55 of the Land Drainage Act, which provided for Sea Defence works costing £22,260 and which was grant-aided at a rate of 40 per cent. of the loan charges over 15 years. In 1936, a five-year programme was approved for similar works to cost £125,000, and this qualified for a 50 per cent. grant over a similar loan period. In 1937, a further scheme estimated to cost £100,000 was approved for grant-aid, and also qualified for a 50 per cent. grant.

The Board are now seeking further grant-aid in respect of works estimated to cost £753,000, to enable their sea defences to be brought up to a reasonably adequate standard over the whole of the area, a programme which will extend over some 15 years.

As a general rule, the work is done by direct labour by the Board's own gangs, which are each more or less local in their activities, although certain key men may be transferred on occasions to help in special works outside their own district. These gangs are supervised by foremen, three in each of the three divisions into which the area is divided, who are responsible to their Divisional Engineer. Generally there are about 320 workmen regularly in the Board's employ, but this number is increased in the autumn, and at times of emergency repairs following gale or tide damage, when the number of men may be as high as 550. Works of a specialized nature are normally put out to contract, but for laying stone for pitching and clay work on walls and constructing the smaller tidal sluices in sea walls, the Board's own workmen are used, as they have acquired a skill in this kind of work which is not generally available under contract conditions. In addition, the men

are employed in river and ditch clearing, and every endeavour is made to keep these men continuously employed.

Until recent years most of the work has been done by hand labour; increasing use is, however, now being made of mechanical plant, and a great deal of sea wall strengthening and river clearing is being done by dragline excavators. The cost of handling spoil on sea wall reconstruction with such machines has been reduced to approximately one-fifth of the cost of equal work by hand labour.

The Board are, in the first instance, concentrating on bringing their sea defence works to a suitable standard of strength, and have been making investigations in this connexion as regards fixing standards of height, but, though it is possible to calculate mathematically the height to which a tide will rise under solar and lunar action, it is a matter of surmise to estimate the level to which the tide may rise when in addition it is subject to atmospheric action. This is sometimes very considerable and records show that the wind blowing in a certain cycle and under certain conditions of atmospheric pressure may add as much as 7 ft. to the calculated level of the tide in the Thames at Southend. Up to the present time an addition of such magnitude has not coincided with the peak of a high spring tide, but there is no reason why it should not do so. The addition to the tide level in January, 1928, in the Thames at Southend at the peak of the tide, was about 5 ft., while at Harwich the addition was about 4 ft. More recently, in December, 1936, the variation from the predicted tide level at Harwich was 3.6 ft. On February 12 this year the Harwich tide gauge gave a reading of 12.1 ft. above O.D. (Liverpool), and that at Southend a reading of 15.1 O.D. These readings were 5.3 ft. and 5.87 ft. respectively above the predicted readings. These exceptional tides were also accompanied by strong winds causing heavy wave action on the sea walls. The Board are accordingly endeavouring to bring up the height standard of their sea walls to such a level as will give reasonable protection against such exceptional tides. The crest level of walls on the Thames Side has hitherto varied from 17 ft. to 18½ ft. above O.D. (Liverpool) according to the position of the particular section of wall in the Thames Estuary, but higher levels than these are under contemplation for particular sections where a greater factor of safety is called for. Elsewhere the standard height is somewhat lower and is related to the height of the tide in the particular locality. The

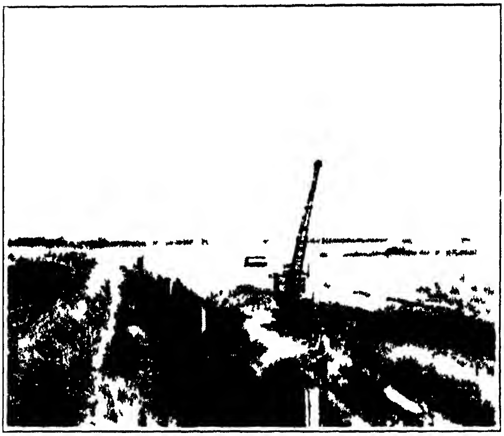


Fig. 1.—Strengthening the Wall. Showing old ditch filled and new drain at 10 ft. from toe

Fig. 2.—Raising Sea Wall

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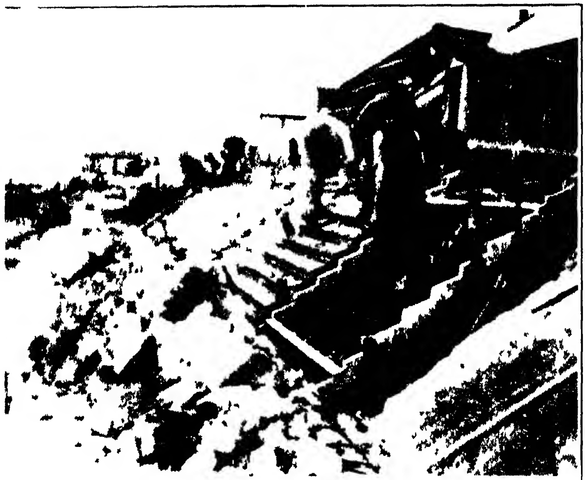


Fig. 3 Sea Wall at Jaywick — Flexible Apron under construction

Fig. 4 Stone Pitching with Bitumen Grouting

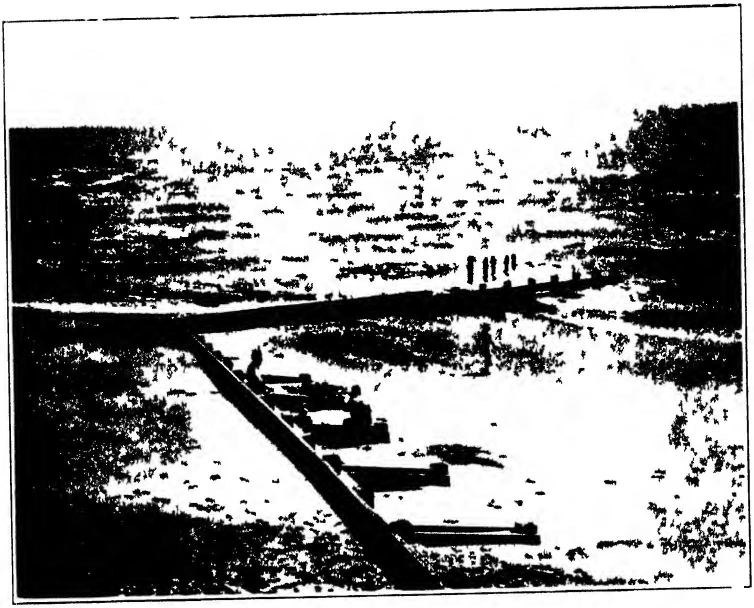


Fig. [illegible] [illegible]

Fig. [illegible] Stepped Wall in Concrete

Fig. Gale Damage to Sea Wall February 1938

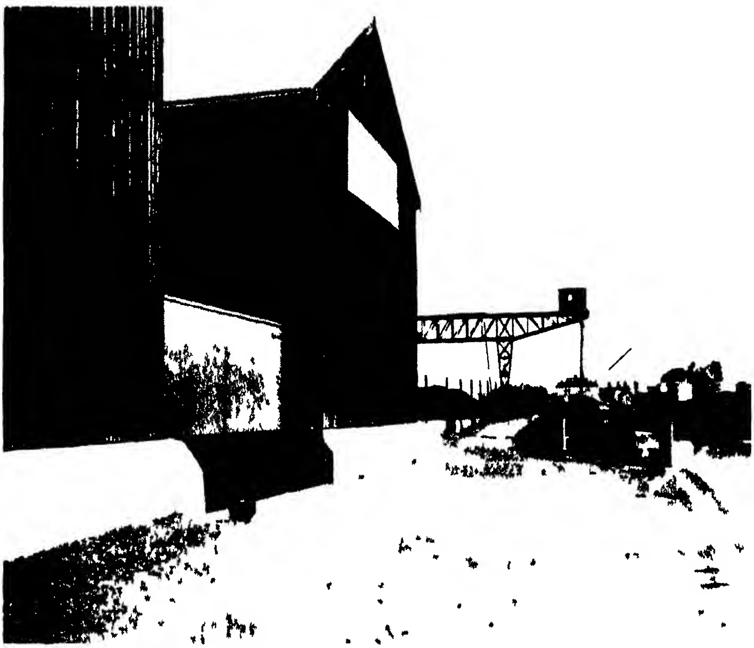


Fig. 8 Protective Concrete Wall against Tidal Flooding in an Industrial Area

levels of the sea walls in the vicinity of Harwich are between 12 and 13 ft. and are to be raised to 14 ft. in the more protected sections above this level where exposed.

Sea wall reconstruction by excavator has been undertaken over a length of approximately seven miles:—Lauriston—Goldhanger, Iltney—Bramble Hall, Heybridge Basin, Maylandsea Bay and Alresford Grange.

Where good clay is available on the marsh in the vicinity of the work, the whole wall is constructed of this material, but where this is deficient the seaward portion of the wall is made up of good clay and the wall is backed by other material. Clay from the saltings or out-marshes has been used in the past by some riparian owners, but its use has been found undesirable, as generally the material is unsuitable and becomes powdery, also the formation of borrow pits in front of the sea wall tends to weaken them.

The standard embankment has a breast slope of 2:1, a back slope of 1½:1 if of clay, stowed by hand, or of 2:1 if of poor material or machine built; and with a crest of 4 ft. minimum width. In addition, opportunity is taken, when reconstructing a sea wall, to fill in the ditch which so frequently runs along the landward foot of the wall, and the borrow pit, which serves as an alternative to the drain filled in, is dug at 30 ft. away from the sea wall, which leaves a cess or berm along the foot of the wall and serves as a useful means of approach along the wall. Mechanical rammers are used for ensuring ample consolidation and every effort is made to get a good protective growth of grass on the walls.

The protection of the seaward face of the wall, where there is a good frontage of salting, is by means of turf, but where there is open water or an exposed frontage, the wall is usually pitched with a layer (9 in. minimum) of Kentish ragstone, closely knit together, dry, and laid on a bedding of chalk or coarse ballast. This stonework is now divided into 12 ft. × 9 ft. panels by elm boarding to localize any slipping, washouts or settlement. This form of stone pitching is a development of the traditional method of protecting the wall, and permits of work being carried out on the higher sections of the wall when the men are put out in the lower sections by the tide. Alternative methods now employed vary from two 12 in. concrete kerbs along the foot of the wall at the level most susceptible to wash, when wash is not excessive, to heavy mass concrete steps, 18 in. high, extending from top to bottom of the wall, with a footing

of steel sheet piling driven into the foreshore where the sea wall is exposed to the open sea. A lighter form of concrete protection has been tried with success, in the form of panels of concrete, 8 ft. square and 6 in. thick, suitably reinforced, each panel free to settle independently in a grid of reinforced concrete beams. The panels are serrated to break the force of water rushing over the slab.

Experiments are being carried out in the use of bitumen-bound pitching for sites exposed to heavy wave action. The stones in the pitching are bound together by pouring a heated mixture of bitumen, sand and asbestos fibre into the joints of the pitching. This method of grouting imparts to the pitching sufficient elasticity to allow it to conform to any settlement or minor washouts of the clay.

Spartina grass has been planted in certain places to arrest mud in suspension in the tidal water and to encourage accretion of foreshore, but progress in this area has been very slow and the plant has not thrived as much as was anticipated. It is probable that the amount of silt in suspension in the water where this grass has been planted is not sufficient to encourage vigorous growth.

Groynes have been erected on the foreshore at Holland Haven and at Jaywick to arrest the southward drift of the beach, and thereby build up a strong foreshore offering additional protection in times of storm. Timber has hitherto been used, but a start is shortly to be made with reinforced concrete groynes which may better withstand attacks of the Teredo Worm. Some of the groynes at Holland and Jaywick were set out on a dog-leg alignment and not straight, and appear to be acting in a positive manner.

Particular trouble has been experienced at Holland Haven where the cliffs terminate eastwards of Clacton. From this point onwards to Frinton there is a low stretch of marsh protected from the sea by a cement-grouted stone-pitched sea wall. The cliffs at this point face the open sea and are subject to heavy wave and current action, and as a consequence there has been heavy erosion along the foot of the cliff, and protection is necessary to stop the decay of the cliffs, which, if allowed to continue, would outflank the sea wall protecting the marshes. A toe of heavy steel piling has been driven, surmounted by concrete steps. A comparatively weak strip of concrete apron has been placed between the piling and the steps so that if further scour takes place it will be possible to

break up this concrete, drive the steel piling to a greater depth, and construct additional stepwork where the apron previously existed. Further groynes are contemplated which it is anticipated will collect sufficient beach material to protect the clay from scour.

At Shellhaven, on the Thames Estuary, erosion and scour at Messrs. Cory's jetties has resulted in the partial settlement of the toe of the sea wall at low-water mark, and under-water soundings taken every six months have revealed the presence of a steep cliff in the clay and peat layers of which the ground here is composed, leading down to dredging level of about 40 ft. below O.D., and on the edge of which the wall rests. As an emergency measure, some 6,000 cu. yd. of Kentish Ragstone were tipped in front of the places affected, and this, after consolidation, appears to have stopped further erosion for the time being, but it is anticipated that future works will be necessary to establish this section of the front.

At Hole Haven, farther downstream, where a new channel is forming in the foreshore, chalk is being tipped to form aprons 3 ft. thick, to stop the progress of erosion near to the sea walls.

There are some 300 or more tidal sluices which provide for the discharge of accumulated land water through the sea walls at low tide. Most of these were constructed of timber, and many were found to be in a decayed and dangerous condition. Reconstruction of these is proceeding at the rate of some 25-30 per annum, and is carried out in mass concrete with concrete tubes and gunmetal-faced, cast-iron tidal flap valves. Where water has to be impounded for stock or otherwise conserved, the sluices are provided with a penstock at the upstream end, or with slots in the wingwalls of the intake into which boards may be placed to form a stank or dam during the summer. The sluices that are being replaced vary in size from 4 in. square to 4 ft. × 10 ft. trunks and, where necessary, twin tubes are now laid through the wall. Where the location of a sluice is particularly vital or exposed, a valve chamber is constructed in the seawall, in which the flap and penstock may be housed, and the outfall pipe is, for strength, of cast iron instead of concrete.

Up to the present time 96 sluices have been rebuilt, the smaller sluices varying in cost from £40 to £400, larger ones, undertaken by contract, from £600 to £3,000. To augment the run-off, balanced tidal flaps are provided in

critical cases. While most of the sluices are automatic, there are some hand-operated sluices maintained by the Board. It is proposed to reconstruct one of these at Holland Haven shortly, and to instal electrical gear for raising and lowering the gate. One problem here will be the prevention of beaching up of the outfall flume in summer when the outflow of land water for several months is nil.

Consideration has also been given to the functioning of the main rivers in time of floods, and in two cases, at Moulsham Mill and Barnes Mill, Chelmsford, the openings of the sluices have been enlarged. At Pointwell Mill, Coggeshall, on the River Blackwater, the floodgates, which had fallen into disrepair, have been replaced by a concrete weir, an additional weir being put in upstream as a relief. Further similar works are contemplated, together with the installation of flumes for measuring river discharge.

Emergency work was entailed in the spring of the present year, owing to the high tides in February, to which reference has already been made. These tides, speaking generally, flowed over the walls all round the Essex coast with the exception of the Thames walls, and caused extensive flooding. Numerous slips and breaches occurred and no less than £33,000 was spent on the reparation of damage. It was particularly gratifying to note that little, if any, damage was done to the work which the Catchment Board had carried out under their grant-aided schemes. It is to be hoped that when these schemes are completed there will be little chance of the recurrence of such flooding rendering, as it sometimes does, considerable acreages of land incapable of use for prolonged periods.

The total area to be directly benefited by the Board's works is approximately 107,000 acres and, as previously mentioned, includes not only agricultural land, but valuable industrial areas along the north bank of the Thames, and a number of areas developed for building.

CROP HUSBANDRY IN THE 18TH CENTURY:* OXFORD, BUCKS AND BERKS

G. E. FUSSELL,
Ministry of Agriculture and Fisheries

South of Northampton and contiguous to the counties already described lie Oxford, Buckingham and Berkshire. The first of these seems to have been always a county where small holdings were common, and, although the yeoman farmers are calculated to have declined between the end of the 16th and the late 18th centuries, the enclosures in the county between 1755 and 1832 did not affect the quantity of land farmed in small lots. This was particularly so in the north of the county and the holdings in the open fields were also small.†[1] Young, indeed, states that the farms were too small for good husbandry,[2] and the earlier reporter tells us that though the size of holding varied greatly, the general average was smaller than in most other counties.[3] This may account for the backward farming in the county, but some net increment was secured because some of the necessities of Gloucester were supplied from this county as well as from Berkshire and from Hereford.[4]

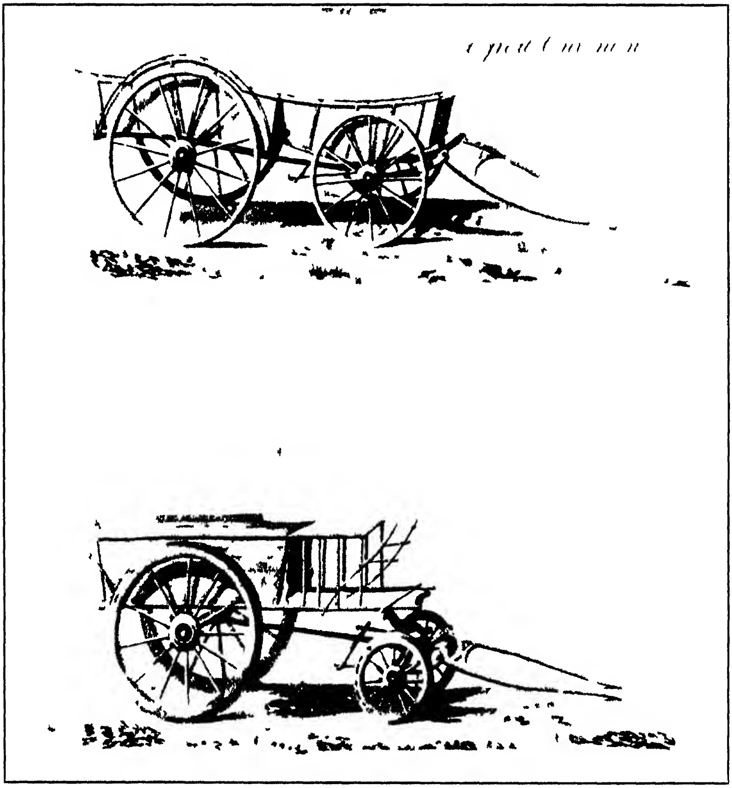
Wheat was always a staple, but maslin (a mixture of wheat and rye) was sown on the poorer lands in the late 17th and 18th centuries, barley or pulse being used as the second crop in the three-field course; on the sands they gave two fallowings (ploughings) for wheat, white or lammas, then a fallow followed by barley. Cone wheat, the common and sprat barley were also grown.[5] Rath ripe barley was grown in the county, but was a native of Wiltshire.[6] Much of the malt produced from the barley was shipped down the Thames from Henley.[7]

Young was never enthusiastic about the farming in Oxfordshire, and, when he first passed through the county in 1770, he found little to say of the land between Chipping Norton and Oxford but that it was poor and in open field. When he got to Bensington he found longer rotations. Rye was cultivated for mowing green for forage and there were tares, turnips, and

* Previous articles in this series have appeared in this *Journal* as follows —Somerset and Wiltshire (Nov, 1936), Herts and Middlesex (Jan, 1937), East Anglia (Apr, 1937), Beds, Cambridge and Hunts (July, 1937), Lincs and Rutland (Oct, 1937), Northants and Leics. (March, 1938).

† For references, see p. 569.

clover. Chalk, rags and malt-dust were used as manure, as were coal-ashes from Oxford. There was some sainfoin, and about Henley there were long rotations. His opinion of the first section of the journey is not shared by Mr. Salmon, who thought they had plenty of compost and fine, fruitful corn-fields as well as some grazing lands in 1744, and Hale mentions the use of chalk and ashes mixed, as well as old rags ploughed into the ridges for fertilizer in 1756.[8] Stebbing Shaw, who visited this county in September, 1789, found the harvest pretty forward and the crops plentiful and well-looking, but more was unfinished and standing than in the part of Buckingham he had just left.[9] This is not very definite information. Young was more explicit when he visited the county again. From Bensington to Oxford there were extensive open fields under the course, fallow, wheat, beans, barley. The land was laid up in high ridges and there was much hoeing and weeding, but the clover was bad and foul. From Oxford to Woodstock and to Chipping Norton the same culture was prevalent, but in the last section there was much paring and burning.[10] This process, which was not general but more common in Gloucester and therefore more prevalent in the parts of Oxford adjoining that county, was done before sowing turnips, although one man had put in oats on burnt land. The system of farming varied throughout the county. In some places crop and fallow followed each other; in others two or three crops were taken before a fallow, and turnips were said to be fairly general in 1794. Opinions as to fallowing differed when Young wrote his report and he suggests that only Norfolk and Suffolk knew a proper rotation forty years before. Drilling was not general and potatoes were apparently only grown in the labourer's gardens or on land allowed to them by the farmers. Sainfoin was grown on all lands suited to it and manured with peat ash probably obtained from Newbury in Berkshire.[11] There seems to be no doubt that the general improvements of the 18th century had not greatly affected this county, although some of the new grasses had been adopted, but the new rotations were not general and so early as 1769 neither the roads nor the husbandry were in such perfection as might be expected,"[12] while Young's account both of the cropping and of the implements show that nothing had altered very greatly. Threshing machines were spreading in the county in 1809 (there were 15), but the other implements were backward. The ploughs had one or two wheels and straight mouldboards. There were



THE BERKSHIRE WAGGON

Nathaniel Kent recommended the Berkshire waggon to the Norfolk farmers as 'being a horse's draught lighter than their own when loaded and being calculated to carry larger loads and much lower, a great convenience'.

(Reproduced from Nathaniel Kent, General View of the Agriculture of Norfolk, 1[illegible]4)

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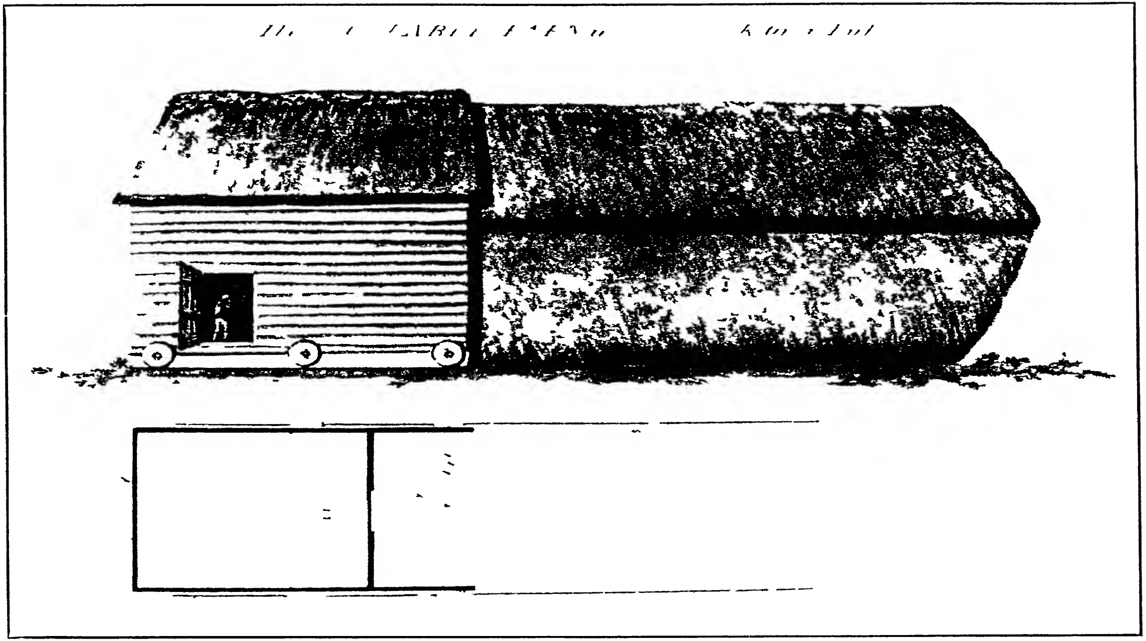

THE MOVEABLE BARN AT WINDSOR GREAT PARK

This curious contrivance shows to what extent ingenuity could be carried by a farmer such as the King, to whom money was no object

(Repro [illegible] from W[illegible] General View of the Agricult[illegible]re of Berkshire 1794)

no horse hoes, although there were some drills, but scarifiers and scufflers were very rare indeed. A roller of twelve wheels had been invented by Turner of Burford and an enterprising Henley farmer had imported some two-horse carts from Northumberland.[13] In this county, as elsewhere, Ernle emphasizes the remarks of the reporters on the advantages of enclosure. For him, as for Young, the open field farmers were Goths and Vandals, whereas the enclosed farms were cultivated by angels of light,[14] but the effect of the enclosure movement in Oxfordshire was not to enlarge the farms, and, although here and there were scattered improvements and new crops and rotations, the county as a whole remained much the same at the end of the century as at the beginning.

Buckingham always enjoyed a reputation for producing good beef and good bread. The statement, indeed, became almost proverbial and was repeated by a number of the topographers. The farms in the county were estimated to average 170 acres in 1813[15] and this seems to show that the earlier reporter's estimate of from £60 to £250 with some few of larger extent probably holds good for the whole of the century.[16] The common field farmers are complained of here as usual,[17] but only 90,000 acres remained in open field at the end of the century. Moreover, in spite of Taylor's contention that long leases were required if improvements were to be undertaken,[18] we learn from the earlier reporters that the leases for twenty years restricted the farmers to two crops and a fallow, or perhaps three. In the southern parts of the county, leases were more liberal, having only a clause against exhausting the soil, and leaving the rotation much to the choice of the tenant.[19] Clover seems to have been introduced to and become popular on the arable of the hills fairly early in the century, for Ellis tells us that Aylesbury Vale tried, at law, to prevent its use there. The Vale, being mostly common fields, could not readily use it for turnips.[20] The great open fields of the Vale were, however, cheap land to cultivate, and yielded good crops although they were strangers to turnips and clover. The farmers used to be much put to it to consume all the stubble for firing, says Ellis.[21] It was also the habit to grow beans as a first crop on newly-broken clay in this county, and in the Vale for Lent Grain. The beans were sown in drills so that the sheep could pass between the rows and keep down the weeds;[22] and in 1750 Ellis states that it was becoming customary to sow barley after the fallow.[23] Hale also informs us that soot and ashes

were used, that marle was known in the county and that chalking was done on the arable both here and in Hertford; the land was also laid up in high ridges for drainage here as it was in Kent, Essex and Huntingdon[24] and, indeed, many other counties.

There was at least one improving landowner, or amateur of farming in Buckingham. The great Edmund Burke himself had a farm at Beaconsfield and here he endeavoured by example to inculcate the use of oxen for ploughing. His neighbours used horses, but he ploughed an acre a day with four oxen, strictly by proxy, it may safely be assumed.[25] Here, as elsewhere, the ploughland was ridged up in the high, crooked, broad lands condemned by the didactic writers, although in the neighbourhood of Hockley, the farmers were feeling their way towards the Norfolk practice in 1785, and flocks were hired from Banbury for folding during the summer. Many of the new enclosures near Stony Stratford had been laid down, but some were arable under improved courses, and near Wycombe an enterprising open field farmer had introduced turnips on two acres and eaten them off with sheep, but we are also told by an acute observer that the new enclosures between Northampton and Newport Pagnell were badly managed in 1792.[26] In the south of the county the form of bad management was to take four white crops in a six-course rotation, although some sainfoin was cultivated, presumably on the chalk. In 1800 many of the beech woods, of which Salmon had said that the south-east of Oxford and the adjacent parts of Buckingham were plentifully supplied, had been grubbed up, although many still remain and some remnants are still in being to-day.[27]

Not much is added to this by the reporters, from whom we learn that the open fields were fallowed once in three years, although turnips were grown on the fallow in the Chilterns and in the east of the county. Some courses were all white crops with an occasional fallow, but the rotations varied in this county as in others. Rye was not grown. Barley was sown after turnips on the clover leys and usually manured. A few oats were grown; peas were rare, but beans general. Tares were cultivated for horses and sheep, clover with the barley, and sainfoin upon the Chilterns, while paring and burning were gaining ground as the best method of bringing swardland to tillage. Marl, chalk, lime, and gypsum were used as manures, the fold being general, but ashes from London, soot

and woollen rags as well as hair and hoofs from Smithfield were also used.[28] The implements do not seem to have undergone very much development, although the threshing machine, that obvious labour-saving device, was becoming more common in 1813. The plough was a heavy foot plough having a long beam and a breast formed of flat boards made to bulge out across the breast so that it became slightly convex. Scarifiers were used in South Bucks, but rollers were, in the opinion of the Rev. St. John Priest, very much wanted for the pastures. Drills were very uncommon and the carts and waggons ordinary.[29]

It is a little difficult to determine the size of holding prevalent in Berkshire at the end of the century. One-third of the county is said to have been in the hands of owner-occupiers and great landlords were rare. Everywhere we find a respectable number of yeomanry and there were in the upper parts handsome seats with not more than 100 acres attached. A high-spirited and independent yeomanry was the characteristic of the county and the average size of farms is stated at £150 of £1 1*s.* 0*d.* land by one reporter. The previous reporter, however, states that the farms were generally large, being rarely under £100 a year, but the average was from £200 to £500 a year, or 300 to 400 acres. On the other hand, in 1761 the farms in both Berkshire and Wiltshire were said to be very large, except in the Vale of White Horse, and there were very lordly farmers and very humble labourers, the size being from £100-350 and from 100-500 acres.[30] The truth is probably that the farms abutting on the Downs were larger than the others, because of the sheep walk which was attached to them.

The district along the Bath road, though it stood in open arable in 1699, is reported the more improved the closer Reading was approached from the west in 1762,[31] but the only other scraps of information for the early part of the century are that in Berkshire and Hampshire it was customary to sow peas on breaking up grass land and that peat was dug and burnt for manure at Newbury, being sold at 4*d.*-8*d.* a peck.[32] The earliest detailed information is provided by Young's tours and even that is not very complete. Near Maidenhead there was very little fallow;[33] the farms in the west of the county and the Vale of White Horse had improved courses and bought seed from Surrey and the Isle of Thanet. The Vale fed its turnips on the land with sheep, both summer and winter tares for sheep and soiling horses were grown, there was a great deal

of sainfoin, peat manure was used on clover, and rags from London used. Near Reading a six-course rotation had been developed and although the wheel ploughs were something like the Norfolk implement, 4 horses were required and a driver. The peas were drilled and hoed with the Berkshire skim.[34]

Ernle points out that the writer of the first report says that there were 220,000 acres of open field and 170,000 acres of enclosed lands in the county in 1794, but he does not add that the reporter also says that there were only 240,000 acres of arable in the county. The 220,000 acres includes downs. In the enclosures there was little fallowing, meliorating green crops being usual. Few oxen were used on the Down farms, 4 horses to a plough being the common number, and in the reporter's opinion there was too much burn-baking here. Dung was used for wheat, turnips were folded and on the downs the sheepfold was the only source of manure, but woollen rags were used for wheat and on clover leys cultivated in light land. Malt-dust was used for barley in the north, but the south showed examples of the best farming in the country. Judicious rotations of five or six courses were used here and in the Vale of White Horse, where the reporter suggested the Norfolk course might be adopted, apparently not realizing that the prevalent course was a modification of that admirable rotation and that such modifications were not unusual in its county of origin. He adds that half the county was still in open field.[35] The later reporter states that 255,000 acres of arable had been enclosed of late years especially on the Downs, and gives details of a great variety of rotations, but does not otherwise add much to what the previous writer has to say, except to point out that insufficient oats for the consumption of the county were produced and that rye, formerly pretty extensively cultivated, had become unfashionable, only small quantities being grown on the downs for sheep feed. Turnips had become general and potatoes were grown on roadside waste, on farms and sometimes on a large scale. The method of sowing was mainly broadcast. An interesting statement is that the peat ashes used for manure were first burnt at Newbury by Mr. Thomas Rudd for clover in 1745.[36] The heavy two-wheel plough was still popular with the ploughman, but cast-iron shares were becoming common, and there were a pressing plough, a mole plough and some other types, but the last were probably exceptions. There were also rollers and harrows,

drills, and several threshing machines, while the carts and waggons were light and elegant.[37]

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AN INVESTIGATION INTO THE BEHAVIOUR OF CERTAIN CIDER APPLE VARIETIES

C. SAVIDGE,
Horticultural Instructor for Herefordshire

For upwards of thirty years the Herefordshire County Council have maintained a small demonstration cider orchard of 6 acres in the grounds of the County and City Mental Hospital, Burghill, Hereford. The lay-out of this orchard and a brief description of its management appeared in the February, 1928, issue of this JOURNAL. In 1931, the writer began a series of detailed observations on the different varieties of trees in this orchard and a scheme of treatment was inaugurated in 1933. The results of this work carried out over a series of years are briefly described in the following article.

The orchard was planted under the National Fruit and Cider Institute scheme in 1908, with the object of comparing the relative merits of some of the recognized good varieties of Herefordshire with those of other counties and hitherto unknown in Herefordshire. The orchard site has a moderate and fairly regular slope with a northern aspect. The soil is of the Old Red Sandstone type, but is contaminated by Welsh glacial drift. It is a good deep loam with the exception of a part along the top bank where it is somewhat stony and only of moderate depth. Details of the mechanical and chemical analysis are given in the Long Ashton Research Station Report for 1922.

Twenty-five varieties were raised at the Research Station, Long Ashton, and the late Mr. A. J. Manning, then County Instructor in Horticulture, personally supervised the laying out and planting of the orchard. The varieties were planted in complete rows of eleven trees per row running from top to bottom of the slope under similar conditions. Distance of planting is 30 ft. square. For several years the land had been liberally treated and at planting time was under seeds, sown in 1907, from which a hay crop was taken in the following year. For five or six years this orchard remained a pasture of poor quality which had occasionally been put up for hay. In 1916, the orchard was ploughed for the cultivation of arable crops during the Great War. As a result, the orchard received generous manurial treatment and the trees made greater growth in consequence.

The orchard was later laid down to permanent pasture which is now grazed mainly by milch cows. In a grass orchard it

is obviously desirable that the grazing should be close and thorough during the period when grazing is possible. The ground should be as free as possible of grass when picking begins, to avoid wastage, which always occurs where the grass has been allowed to grow overlong. Further, strict control of the grazing induces a better quality of pasture. These points have not always been attended to in many grass orchards, including the one under present consideration.

The orchard has not received any extra manurial treatment beyond occasional dressings of nitrogenous and phosphatic fertilizers and is under the control of the Committee of Visitors. It is with their kind permission, and assistance from the Clerk and Steward, and Farm Bailiff, that the following data has been recorded.

Procedure. The main purpose of the investigations started by the writer in 1931, was to consider first the cropping propensities and growth characters of the varieties over a period of years, and secondly, certain pathological features of the varieties. Later, it seemed desirable to consider the major problems relating to the control of pests and diseases, and particularly the economic aspects of suitable spraying treatments. Would the control measures which are now an established practice on commercial fruit farms effect a marked increase in cropping and improve the general health and vigour of cider varieties? The average yield for cider orchards is low compared with the yield of market varieties. Could this low average be raised if a suitable spraying programme was carried out? As the number of spray applications given in commercial orchards of market varieties are many, would a similar or modified programme be an economical procedure in view of the relative lower returns obtained for vintage fruits? Since spraying as a method of pest and disease control is not an established practice in cider orchards, the experience gained in the spraying of market varieties had to be used as a basis. Particularly is this so in the control of apple scab on vintage varieties; and no experience or experiments were available for reference to show the response of cider apples from insecticidal and fungicidal sprayings.*

With the above considerations in mind regarding spraying, it was clear that it would be wise at first to find the effect of tar

[1] Swarbrick, T. (1932). The Spraying of Farm Orchards as a Means of Increasing the Cider Fruit Crop *Ann Rept Agric and Hortic. Res. Sta.*, Long Ashton, 1932, pp. 47–65.

oils only. If winter spraying was beneficial, additional applications of a fungicide in the spring might also prove economically satisfactory. On the other hand, however, the combined sprayings might prove too costly, especially in a light crop year, and not repay the expenditure of spraying. In subsequent years, therefore, one, or perhaps both, sprayings could be omitted. The purpose of the present article is to consider the information and statistical data collected for six cropping seasons for the purposes of record, and for the sake of certain conclusions which the results indicate.

Observation on the Varieties. The cropping of the orchard, now twenty-nine years old, gives an indication of the state of the orchard. The following summary shows a number of varieties which are proving to be of some value under certain local conditions where others are failing to crop satisfactorily. This summary only deals with 21 of the 25 varieties originally planted. The remainder, viz., Killerton Sweet, Somerset Redstreak, Butleigh No. 14, and Medaille D'or, are not included owing to rogue varieties and regrafting. The yields from these four rows, together with the odd trees in the corner of the orchard are, however, included in the final statement of costs and returns of the whole orchard. In summarizing the cropping propensities of the 21 varieties it will be seen that ten varieties have cropped well during the six year period. The average annual yield per tree during this period is given for each variety.

*YARLINGTON MILL. 2 cwt. 29 lb Fairly large, strong, spreading trees; the foliage is dark in colour and very healthy. The trees are often pendulous with the load of fruit and the branches are inclined to break down unless supported. Four trees were badly damaged from this in 1933. The fruit is medium to large in size, and free from apple scab. A slight attack of woolly aphis was first recorded in 1937.

*CRIMSON KING. 2 cwt. 20 lb Large to very large, strong spreading trees with very healthy foliage. Fruit is medium to large, and clean Variety planted and labelled as Broad Leaved Jersey, but identified by P. T. H. Pickford as Crimson King.

SWEET COPPIN. 1 cwt 93 lb. Large to very large, spreading trees with good foliage. Fruit is moderate to large and resistant to scab. Slight attacks of woolly aphis, 1936 and 1937; and red spider, 1936.

NO. 32 ASHTON. 1 cwt. 70 lb. Fairly large to large, strong spreading trees with very healthy foliage. Fruit is medium in size and scab free. Would probably improve if manured.

*FAIR MAID OF DEVON. 1 cwt. 69 lb. Fairly large to large, strong, spreading trees; much healthy foliage. Fruit is of medium size, scab free; very susceptible to brown rot and slightly prone to apple sawfly. Badly infested with woolly aphis since 1933.

*DABINETT. 1 cwt. 67 lb. Small to fairly large, spreading trees with good foliage. Fruit medium size and scab free. Some spider in 1936. In proportion to size is the heaviest cropping variety.

IMPROVED POUND. 1 cwt 60 lb. Fairly large to large, strong, umbrella shape spreading trees with the largest trunk girth. Branches inclined to droop and become damaged by stock. Fruit is large and scab free. Is slightly susceptible to mildew, otherwise the foliage is healthy.

COURT ROYAL. 1 cwt. 37 lb Fairly large to large, strong, spreading trees; pendulous with fruits and inclined to droop and become damaged by stock Foliage generally very healthy, light in colour, and often subject to caterpillars Fruit is moderately large, slightly prone to scab, brown rot, and sawfly Subject to *Cytospora* and slight attack of woolly aphis 1937.

*SWEET ALFORD 1 cwt. 21 lb. Fairly large to large trees of spreading compact habit Prior to lime-sulphur treatment the foliage varied from moderately to very healthy but prone to mildew. Fruit of medium size and occasionally scab marked. Scab pustules present on wood but not sufficient to damage leaves or fruit. Subject to *Cytospora* and slight infestations of spider.

*KINGSTON BLACK. 1 cwt. 13 lb Fairly large to large, spreading trees. Fruit is small to medium size, and generally scab marked. Very susceptible to scab, mildew, and spider. The cropping and vigour of this valuable variety has greatly improved as a result of spraying, particularly from lime sulphur. Would probably respond to increased manuring, especially potash.

CHERRY NORMAN 3 qr. 21 lb Very large spreading trees, probably largest head in orchard and variable foliage. Fruit is small and often scab marked Susceptible to canker, *Cytospora*, scab, red spider, woolly aphis Would probably improve by good manuring.

STRAWBERRY NORMAN 3 qr. 18 lb Large to very large trees with fairly strong spreading branches of drooping, and almost horizontal habit. Foliage is good Fruit is of medium size and scab marked. New growths susceptible to canker and scab but much improved by lime-sulphur treatment. Slight infestations of spider, 1936, and woolly aphis, 1937. Bad attack of blossom weevil, 1936. Subject to *Cytospora*.

KINGSTON BLACK IMPROVED 3 qr 11 lb Fairly large to large trees of spreading habit with good foliage Fruit is of medium size and more resistant to scab than Kingston Black Slightly prone to red spider and badly infested with sawfly in 1936

*KNOTTED KERNEL. 3 qr 7 lb Very large, tall, compact, vigorous, upright trees with healthy foliage. Fruit is small and clean Red spider and some defoliation from leaf miner in 1936 Slight attack of woolly aphis, 1937 Blossoms late and is late in coming into full bearing.

*CAP OF LIBERTY. 2 qr. 7 lb. Small to fairly large spreading trees. Foliage is healthy in spring, but later often scab marked in spite of fungicidal treatment. Fruit of medium to large size, scab marked and often susceptible to water-core. Variety is subject to *Cytospora*, scab, spider, and sawfly.

HEREFORD REDSTREAK. 1 qr 17 lb Fairly large trees, slightly upright, with poor foliage. Fruit is medium to large size and scab marked. Very susceptible to shoot and spur canker, apple scab and spider. Woolly aphis recorded 1936 and 1937.

COWARNE RED. 1 qr. 12 lb. Small to fairly large trees of compact upright habit and poor foliage. Fruit is small and scab marked. The branches and young shoots canker and die-back badly and the variety is very subject to apple scab and caterpillars.

Skyrmes Kernel. 1 qr. 11 lb Small trees of compact habit and poor foliage showing leaf scorch. Fruit is small and scab marked. This variety is very susceptible to canker, *Cytospora*, scab and mildew.

*Eggleton Styre. 1 qr 10 lb Fairly large to large, tall, upright, and compact trees with fairly good foliage Fruit is of medium size and scab marked Susceptible to canker, *Cytospora*, scab and leaf scorch. Responds to spraying

*Old Foxwhelp. 1 qr 13 lb Very small, spreading trees with healthy foliage slightly prone to mildew. Fruit is of medium to large size and clean. Is occasionally badly attacked by blossom weevil, is resistant to scab and general condition much improved by spraying The form of the fruit does not seem to be the true Old Foxwhelp Subject to *Cytospora*.

*Dymock Red (Ashton) 11 lb Large, spreading trees inclined to upright growth Fruit is of medium size and scab marked Shoot and spur canker, scab, mildew and leaf scorch make this variety almost leafless in August The variety is also susceptible to *Cytospora*, and woolly aphis, 1936 and 1937.

* Varieties recommended conjointly by the Ministry of Agriculture, National Farmer's Union, and the National Fruit and Cider Institute Long Ashton.

Observation on Tree Spraying. Winter spraying of this orchard by means of tar-distillates was first carried out during March, 1933, the whole orchard being sprayed by certain inmates in charge of an attendant. The spray programme consisted of tar oil at 6 per cent., and was applied by means of a small portable manual outfit at an estimated total cost of £25 for the six acres. Doubtless as a result of the pruning received the previous winter, also the spray treatment, and encouraged by the favourable season, the orchard produced the heaviest crop since it was planted. Although efficiently carried out the work was costly and from this time forward all the tree spraying has been done by the County Council power sprayer† at considerably less cost.

In Table I the total quantities and costs of spray fluids, labour, times and costs of application are grouped together for the purposes of comparison and to assist cider-apple growers in estimating such work under similar conditions.

The costs of application, 1934-36, include charges for fuel and oil; repairs and replacements, but exclude charges for depreciation of plant and interest on capital. Also included are the wages of one or two men, viz., supervisor and engineer. The charges for spraying labour are for the spray gang provided by the owners of the orchard. These men, usually patients, worked under the direct supervision of the supervisor when the engineer was employed with the engine, or an

† See this Journal January, 1935, p 965.

TABLE I.—WORKING COSTS

		1931	1932	1933	1934	1935		1936	
				Winter	Winter	Winter	Spring	Winter	Spring
		£ s. d.	£ s d	£ s. d.	£ s d.	£ s. d	£ s d.	£ s d	£ s d.
*1933	1,400 gal @ 7½ per cent, March								
	100 gal tar dist								
	Total costs .	—	—	25 0 0	—	—	—	—	—
1934	1,500 gal. @ 6 per cent, March 22–23								
	90 gal tar dist @ 1s. 5¼d	—	—	—	6 9 4½	—	—	—	—
	Application costs (including 2 men)	—	—	—	2 1 4	—	—	—	—
	Labour, spraying @ 7d an hour .	—	—	—	1 0 8½	—	—	—	—
1935	1,700 gal @ 6 per cent, March 25–26.								
	100 gal tar dist @ 10½d	—	—	—	—	4 7 6	—	—	—
	Application costs (including 2 men)	—	—	—	—	1 17 6	—	—	—
	Labour, spraying @ 7d. an hour .	—	—	—	—	0 14 0	—	—	—
	1,200 gal @ 1 in 30 April 16 (green flower)								
	40 gal lime sulphur @ 1s 4d	—	—	—	—	—	2 13 4	—	—
	Application costs (including 1 man)	—	—	—	—	—	1 4 4	—	—
	Labour, spraying @ 7d. an hour .	—	—	—	—	—	1 0 5	—	—
	1,800 gal @ 1 in 60 May 9–10 (petal fall)								
	30 gal. lime sulphur @ 1s. 4d	—	—	—	—	—	2 0 0	—	—
	Application costs (including 1 man)	—	—	—	—	—	1 4 4	—	—
	Labour, spraying @ 7d an hour .	—	—	—	—	—	0 13 5	—	—
1936	1,400 gal @ 7½ per cent, March 16–17								
	100 gal tar dist @ 1s. .	—	—	—	—	—	—	5 0 0	—
	Application costs (including 1 man)	—	—	—	—	—	—	2 7 6	—
	Labour, spraying @ 7d an hour	—	—	—	—	—	—	0 16 4	—
	1,500 gal. @ 1 in 30, May 1 (green flower)								
	50 gal lime sulphur @ 1s	—	—	—	—	—	—	—	2 10 0
	Application costs (including 2 men)	—	—	—	—	—	—	—	2 6 4
	Labour, spraying @ 7d an hour	—	—	—	—	—	—	—	1 1 10½
	1,800 gal @ 1 in 60, May 28–29 (petal fall)								
	30 gal. lime sulphur @ 1s	—	—	—	—	—	—	—	1 10 0
	Application costs (including 2 men)	—	—	—	—	—	—	—	2 6 4
	Labour, spraying . . .	—	—	—	—	—	—	—	0 14 0
	COSTS OF SPRAYING PER SIX ACRES	—	—	25 0 0	9 11 5	6 19 0	8 15 10	8 3 10	10 8 6½
Costs of spraying per acre (48 trees) winter		—	—	4 3 4	1 11 10¾	1 3 2	—	1 7 3½	—
,, ,, ,, ,, ,, green flower		—	—	—	—	—	0 16 5	—	0 19 8½
,, ,, ,, ,, ,, petal fall		—	—	—	—	—	0 12 11½	—	0 15 0
,, ,, ,, tree winter		—	—	0 1 8½	0 0 8	0 0 5½	—	0 0 6½	—
,, ,, ,, ,, green flower		—	—	—	—	—	0 0 4	—	0 0 5
,, ,, ,, ,, petal fall		—	—	—	—	—	0 0 3½	—	0 0 3½

(Continued overleaf)

TABLE I—*continued*

	1931	1932	1933	1934	1935	1936
	£ s d	£ s d.	£ s. d	£ s. d	£ s d	£ s. d
Costs of spraying	—	—	25 0 0	9 11 5	15 14 0	18 12 4½
*Share of pruning (1932)	—	2 4 4¾	2 4 4¾	2 4 4¾	2 4 4¾	2 4 4¾
* ,, manures	4 4 0	4 4 0	4 4 0	4 4 0	4 4 0	4 4 0
*Labour, shaking @ 7s ton	1 12 0	0 14 8½	9 16 8½	1 12 2½	5 13 2¾	10 14 2½
* ,, picking @ 7s ton	1 12 0	0 14 8½	9 16 8½	1 12 2½	5 13 2¾	10 14 2½
*Carriage @ 4½d per ton per mile	0 5 0¾	0 2 3	1 11 6	0 5 0¾	0 18 3	1 14 3¾
TOTAL COSTS	7 13 0¾	8 0 0¾	52 13 3¾	19 9 3½	34 7 1¼	48 3 6
AVERAGE TOTAL COST PER TREE	0 0 6¼	0 0 6¾	0 3 8	0 1 4½	0 2 4½	0 3 4

* These figures are estimated as true as possible. The remainder are actual

attendant when the engineer was absent. The supervisor attended the machine on such occasions. The plant used for the work consists of a 5 h.p. semi-portable machine capable of maintaining a pressure at the pump of 250-300 lb. per sq. in. The machine is provided with 1,000 ft. of steel main (67 lengths), flexible couplings, and 1,500 ft. of ½-in. rubber hose in 5 × 300 ft. lengths to assist handling. This substantial gift was presented to the Agricultural Education Department in January, 1934, by Messrs. H. P. Bulmer and Co. Ltd., Cider Makers, Hereford, for the purpose of spraying Herefordshire cider orchards at bare costs.

Five 9-ft. aluminium alloy spray lances fitted with single adjustable nozzles were first used with this machine in 1934. These were suitable for small trees, but a change was made to spray guns in orchards where the trees were tall and fully grown. The use of spray guns was discontinued the following winter and lances were fitted with Noblox pattern 2-jet nozzles for subsequent spraying. Since the spring of 1935 a 6-ft. duralumin lance with a Broadway double nozzle† has also been used. Both types give a good "carrying" and long spray, and are more satisfactory than spray guns and single adjustable nozzles with this outfit.

In Table II an attempt is made to show the time taken per acre for one winter spraying with tar-oil, and two spring sprayings with

† See this JOURNAL August, 1934, p. 433.

TABLE II — COSTINGS OF SPRAYING

		Winter, 1933–1934		Spring, 1935 Green Flower		Spring, 1935 Petal Fall	
		min	sec	min	sec	min	sec.
LABOUR PER ACRE —							
Waste time, bad weather		15	00	00	00	00	00
Orchard delay*		40	00	20	00	30	00
Loading and road haulage, including delays		30	00	15	00	15	00
Unproductive time, laying-out, uncoupling, etc		35	00	50	00	34	00
Actual spraying time†		80	00	70	00	60	00
		200	00	155	00	139	00
*Deduct patients' journeys to and from Hospital		34	35	22	17	17	17
		165	25	132	43	121	43
		= 2¾ hours		= 2 hours		= 2 hours	
No of men spraying	5 @	35	00	70	00	00	00
	4 @	45	00	00	00	50	00
	4 @	00	00	00	00	10	00

TABLE III — STATEMENT OF RETURNS AND COSTS

Tons	Cwt					1931 £ s d	1932 £ s d	1933 £ s d	1934 £ s d	1935 £ s d	1936 £ s d
0	6¾	Kingston Black and Foxwhelp	@	140/–	per ton	2 7 3	—	—	—	—	—
4	4½	Other varieties	@	95/–	,,	20 1 4½	—	—	—	—	—
0	0	Kingston Black and Foxwhelp	@	145/–	,,	—	—	—	—	—	—
2	2	Other varieties	@	125/–	,,	—	13 18 3	—	—	—	—
1	17¾	Kingston Black and Foxwhelp	@	120/–	,,	—	—	11 6 6	—	—	—
26	4¼	Other varieties	@	95/–	,,	—	—	124 10 2¼	—	—	—
0	1	Kingston Black and Foxwhelp	@	105/–	,,	—	—	—	0 5 3	—	—
4	11	Other varieties	@	82/6	,,	—	—	—	18 15 4½	—	—
1	8	Kingston Black and Foxwhelp	@	120/–	,,	—	—	—	—	8 8 0	—
14	15½	Other varieties	@	82/6	,,	—	—	—	—	60 18 11¼	—
2	15	Kingston Black and Foxwhelp	@	110/–	,,	—	—	—	—	—	15 2 6
27	17	Other varieties	@	82/6	,,	—	—	—	—	—	114 17 7½
Value of grass @ 25/– per acre						7 10 0	7 10 0	7 10 0	7 10 0	7 10 0	7 10 0
NET RETURNS						29 18 7½	21 8 3	143 6 8½	26 10 7½	76 16 11¼	137 10 1½
Less costs						7 13 0¾	8 0 0¾	52 13 3¾	19 9 3½	34 7 1¼	48 3 6
SURPLUS						22 5 6¾	13 8 2¼	90 13 4¾	7 1 4	42 9 10	89 6 7½

Net surplus over 6 years .. £265 4s 11d

lime sulphur—the first to obtain ovicidal control of apple aphis, sucker, and a proportion of caterpillars; the latter in order to reduce infestations of apple scab and red spider mite. It will be observed that the actual working time per acre amounts to 2¾ and 2 hours respectively for the winter and spring sprayings. Spray lances were used throughout, and, as a result of winter spraying, excellent controls of aphis, sucker, and caterpillar have been obtained each year. The cropping of the varieties susceptible to scab and canker have also improved from the lime-sulphur treatments. Woolly aphis, recorded for the first time in 1933, on the variety Fair Maid of Devon, is unfortunately increasing and infesting other varieties. Also following upon the tar-oil treatments, infestations of red spider mite are heavier. Good control of this pest, however, is being obtained by the post-blossom sprayings of lime sulphur. The pre-blossom sprayings did not effect control.

The special difficulties that arise in an orchard of mixed varieties made it impossible to apply lime sulphur when all varieties were in the green flower stage. Spraying therefore takes place when the majority are in this stage. No spray damage occurred from this pre-blossom spraying in 1935, although the varieties Cherry Norman, Yarlington Mill and Court Royal were slightly damaged in 1936. It is curious to note, however, that no signs of damage were observed on any variety in mid-June. In 1937, the orchard was sprayed pre-blossom with lime sulphur 1 in 30 on May 5, and post-blossom with lime sulphur 1 in 60 on June 8. Details of sulphur-sensitiveness were taken mid-June and recorded as follows:—

No Scorch—Dymock Red, No 32 Ashton, Knotted Kernel, Cap of Liberty, Eggleton Styre, Sweet Alford, Cowarne Red *Very Slight Scorch*—Kingston Black *Slight Scorch*—Kingston Black Improved, Yarlington Mill, Court Royal, Crimson King, Skyrmes Kernel, Improved Pound *Noticeable Leaf Drop.*—Hereford Redstreak, Cherry Norman, Fair Maid of Devon, Strawberry Norman *Considerable Leaf Drop*—Dabinett, Sweet Coppin, Old Foxwhelp.

Conclusions. The foregoing data indicate the wide variations in the growth and cropping of the varieties. The chief reason for the variability is the resistance or susceptibility of certain varieties to apple canker or apple scab. The evidence accumulated is all in support of the view that the winter and spring spray treatments have effected a marked increase in the cropping, health and vigour of most varieties.

There is no doubt that winter spraying carried out since 1933 has been of inestimable value. The cost of this work has ranged between 1*s*. 8¾*d*. and 5¾*d*. per tree. The annual lime sulphur sprayings since 1935 have resulted in improved vigour and better yields of cleaner fruit from several varieties. Further, there seems to be less tendency to biennial cropping of the varieties. The cost of this treatment varied between 5*d*. and 3¼*d*. per tree. It may be well to mention here that a probable record crop in 1935 was much reduced by frosts in May.

The observations on the incidence of red spider mite suggested that it was unwise to continue yearly applications of tar-oil without at the same time applying lime sulphur during the post-blossoming period. Further, since woolly aphis infestations have also increased, extra control precautions are desirable in future. Finally, the connexion between yields and receipts from the treatments given can be seen by comparing the costs and returns in the Statement, Table III. This table shows at the end of six years, there was a profit of £265 on the six acres, or £7 7*s*. per acre per annum. It is, however, noteworthy to record that a profit of £516 from six acres of the six heaviest cropping varieties, or £14 per acre per annum is probable. This is very satisfactory, considering the trees are not yet in full bearing. No interest on capital, depreciation on implements, or rent has been debited, neither has the annual appreciation of the orchard, or income from competitions, amounting to £28, been included on the credit side. In conclusion, it is hoped this investigation will indicate some economic cultural practices of cider-orchard renovation and elucidate the main problems affecting them.

THE IMPROVEMENT OF POOR GRASS LAND BY POULTRY

L. T. LOWE, B.Sc., N.D.A., F.I.C.,
Institute of Agriculture, Usk, Monmouthshire

It is well known that in certain parts of the country, e.g., the Downlands, the keeping of poultry has resulted in a marked improvement of the grass land, and even in Monmouthshire, where the soil is light and the rainfall high—a combination of factors that has the effect of washing out much of the soluble matter and tending to leave the land sour and poor in plant food—it is apparent to a cursory observation that a similar improvement in the grass land is being effected by poultry, which, in recent years, have been kept on an increasing area. Bent has largely disappeared where poultry have been run; wild white clover is more in evidence, and the better grasses —cocksfoot, perennial rye grass and crested dogstail—are clearly holding their own. This improvement in the quality of the grass land is important from the point of view of the poultry industry itself, apart from any other consideration.

There has been an alarming increase in mortality during the last few years, more particularly among stock kept under intensive conditions, which has induced some poultry farmers to advocate less intensive feeding so as to encourage the birds to consume more "natural" food. In such circumstances, the importance of good grass land is obvious. Then, again, although the protein requirements of birds of various ages and types are not accurately known, experiments by Prentice[1]* and others with laying stock on grass land have given as good results with cereal rations (mash and grain) plus a small percentage of salt as with the commonly fed but more expensive mixtures including protein concentrates, such as fish, meat, or soya-bean meals. This would indicate either that the protein requirements of laying birds are usually overestimated or that such stock are able to obtain a considerable proportion of their protein from grass, insects, worms and so forth. In this connexion, however, it may be admitted that the recent work at the National Institute of Poultry Husbandry[2] appears to support the first alternative, and while therefore

* For references, see p 585.

the value of grass land as a source of protein for poultry remains to be definitely determined, the importance of good grass land is clearly seen in other directions. For instance, advisory work in Monmouthshire has revealed instances of unsatisfactory growth and bone formation in young birds where the soil has been sour and the herbage deficient in lime. The operation of the Land Fertility Scheme, however, has led to a large increase in the number of requests from poultry farmers for advice on the manuring of their grass land, more particularly as to whether applications of slag are needed. It was therefore decided to investigate the feeding value of the herbage from poultry farms and to estimate the improvement in fertility resulting from heavy stocking of the land with the object of obtaining information on manurial requirements. The results of some previous work on this subject by Ling and Muir[3] carried out on very different types of soil and herbage from those of Monmouthshire were reported in this JOURNAL in *February*, 1937.

Improvement in Soil Fertility. Five centres were selected and samples of soil were taken during the autumn of 1937 both from the areas where no poultry had run and from the ground stocked with birds. The soils examined varied somewhat in character, but all could be described as light or medium loams overlying the Old Red Sandstone. Each sample was obtained by mixing thoroughly the earth from about 12 borings (9 in. deep). The corresponding "no poultry" and "poultry" samples in each set were taken from strips a few yards apart immediately inside and outside the wire. The analyses are shown in Table I, and are divided into two classes according to whether the land had carried laying or young stock. Attention was confined to the determination of the lime, phosphate, and potash contents of the soils.

It will be observed that young stock and laying birds had the same general effects on the composition of the soil.

(i) Lime was removed. This was indicated by a fall in the pH and an increase in the lime requirement, or, where excess lime was initially present, a drop in the percentage of carbonate of lime.

(ii) Phosphates were supplied to the soil, as shown by the very pronounced rise in the percentage of available phosphoric acid. Thus the effect of the poultry manure was equivalent to a heavy dressing of a phosphatic fertilizer, such as superphosphate, basic slag, rock phosphate, or bone manure. This was probably the most important factor in the improvement of the herbage and is confirmed by the increase in the percentage of phosphoric acid in the herbage (see Table II). The high

proportion of this constituent in the ash of most poultry foods, as, for example, the cereals, appears to explain this large increase in the phosphoric acid content of the soil.

(iii) There appears to be some removal of potash from the land.

TABLE I

I. LAYING STOCK

	Centre 1		Centre 2		Centre 3		
	No Poultry	Poultry	No Poultry	Poultry	No Poultry	Poultry (middle of run)	(near house)
pH	7·3	6 8	6·5	5 8			
Carbonates (Percentage Carbonate of Lime)	8·58	0·36	Nil	Nil	*	*	*
Lime Requirement (Cwt. per acre Carbonate of Lime)..	Nil	Nil	11·5	40·5	*	*	*
Available Phosphoric Acid (P_2O_5) (Percentage) .	0·007	0·035	0·004	0 013	0·014	0·053	0·057
Exchangeable Potash (K_2O) (Percentage)	0·040	0·030	0·019	0·007	0·058	0·031	0·023

* At Centre 3 the ground had been recently limed, so that the estimations of lime content were of no value for the purpose of this experiment.

II YOUNG STOCK

	Centre 4		Centre 5	
	No Poultry	Poultry	No Poultry	Poultry
pH	6·9	6·4	6·2	5 8
Lime Requirement (Cwt per acre Carbonate of Lime) ..	Nil	6	21	50
Available Phosphoric Acid (P_2O_5) (Percentage) ..	0·016	0 023	0·010	0·013
Exchangeable Potash (K_2O) (Percentage)	0·025	0·019	0·024	0·016

NOTE —The pH was estimated colorimetrically using Kuhn's method, the lime requirement by Hutchinson and McLennan's method, the available phosphoric acid by extraction with 1 per cent. citric acid (Dyer's method), and the exchangeable potash by leaching with N/2 acetic acid (Williams' method).

Improvement in Feeding Value of the Herbage. Three centres were chosen and samples of the herbage were taken in autumn, 1937 (October to December) and again in spring, 1938 (March to April). It seemed probable that, in the absence of facilities for regular cutting of the herbage, better comparisons could be obtained at these times of the year than during the period of rapid growth. At each centre the "no

poultry" herbage had been grazed by cattle or sheep. As far as possible, material of about the same length was chosen for the two samples taken at each centre.

Attention was confined to the protein content, the ratio of lime to phosphoric acid as an index of the suitability of the herbage for bone formation (for which a ratio of lime/phosphoric acid of approximately 1.2/1 is required), and to the accessory factors readily estimated by chemical analysis, viz., carotene (the source of vitamin A in green material) and vitamin C (ascorbic acid). The figures given below are calculated on the dry matter of herbage.

TABLE II

I. AUTUMN SAMPLES

	Centre A		Centre B		Centre C	
	No Poultry	Poultry	No Poultry	Poultry	No Poultry	Poultry
Crude Protein (Percentage) ..	12·41	23·83	4 64	18·59	5·26	21·02
Oxide of Lime (CaO) (Percentage) ..	0·36	0·49	0 40	0·28	0·58	0·31
Phosphoric Acid (P_2O_5) (Percentage)	0·45	0·99	0·36	1·00	0·25	0·97
Ratio: Lime/Phosphoric Acid ..	0·8/1	0·5/1	1·1/1	0·3/1	2·3/1	0·3/1

II SPRING SAMPLES

	Centre A		Centre B		Centre C	
	No Poultry	Poultry	No Poultry	Poultry	No Poultry	Poultry
Crude Protein (Percentage) . ..	15·61	23·48	4·26	13·30	5·18	18·20
Oxide of Lime (CaO) (Percentage) ..	0·40	0·89	0·56	0·61	0·32	0·61
Phosphoric Acid (P_2O_5) (Percentage)	0·41	0·89	0·23	0·48	0·22	0·75
Ratio: Lime/Phosphoric Acid	1·0/1	1·0/1	2·4/1	1·3/1	1·5/1	0·8/1
Carotene (in mg. per 100 grm.).. ..	13·3	40·7	19·3	46·3	8·4	48·0
Ascorbic Acid (in. mg per 100 grm.) ..	52·1	246·7	92·6	250·1	29·3	201·1

NOTE—The protein, lime, and phosphoric acid were estimated by the conventional methods; carotene was determined colorimetrically in the Lovibond tintometer (Ferguson and Bishop's method), and ascorbic acid by titration with 2·6-dichlorophenolindophenol (Harris, Birch and Ray's method)

Some of the differences shown above are very striking. It is recognized that the improvement is not entirely due to the poultry manure but in part results from the intense mechanical treatment the herbage receives from the grazing and scratching by the birds. Coarse " mats " of bent are torn up and opportunity is given for the spread of wild white clover and the better grasses. Further, the close grazing by the birds in spring and autumn, when the growth is not too rapid, keeps the grass in the young and highly nutritious stage, although this would not be so during the flush period of growth. The figures do, however, represent the sum-total of the improvement effected by heavy stocking with poultry.

It was rather unfortunate that the early spring of 1938 was abnormally dry as this had the well-known effect of depressing the phosphoric acid content of the herbage at Centres B and C and thus giving a higher lime / phosphoric acid ratio than would be obtained in a normal spring. The ratios in the autumn samples illustrate very markedly the effect of lack of lime in the soil.

Conclusions. (i) Regular liming of land stocked with poultry is essential to maintain the fertility of the soil and the lime content of the grass. Neglect of this treatment results in a dangerously low ratio of lime to phosphoric acid in the herbage; this will have ill effects on growth and bone formation in young birds unless the deficiency is made good by the inclusion of limestone in the ration. The latter practice will not, however, improve the soil or herbage, and it appears preferable that the stock should obtain lime as far as possible direct from a balanced food rather than as a supplement.

(ii) Phosphatic manures are unnecessary, but small dressings of potash appear to be required on light soils under a heavy rainfall.

(iii) Where sufficient lime is present in the soil, the folding of poultry on grass land offers great possibilities of improving the fertility of the soil and the quality of the herbage.

(iv) Herbage from poultry runs is a valuable food rich in protein, phosphoric acid, and in vitamins A and C. There appears to be at least a *prima facie* case for a reduction in the quantity of protein-rich concentrates, such as fish, meat, or soya-bean meals, included in rations with the object of causing a greater consumption of green food. Such a modification of the ration would effect a considerable saving in food costs

and would ensure that the birds were supplied with the above vitamins.

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SEPTEMBER ON THE FARM

R. W. WHELDON, D.Sc.,
King's College, Newcastle-upon-Tyne

In many localities hay and corn harvests have overlapped this season. In the later districts hay crops have proved better than was at first anticipated, especially in the west and north. The increase in the crops obtained has, however, been offset by the weathered condition of the hay made in unfavourable weather. The importance of good quality hay for winter stock is well recognized. Where a sufficient supply of roots is available, the effects of poor quality hay are not felt to the same extent, and it is fortunate that in many areas there is promise of good root crops. The all-grass farmer, who is often dependent on hay alone for feeding, is likely to suffer most when inferior hay is obtained. Animals do not consume weathered hay with relish; they tend to eat less than is required for the maximum or desired increase, and supplementary feeding usually becomes necessary.

Cereals. During the past few weeks the writer has seen a good deal of the country, and it is remarkable how cereal crops have grown during such an abnormally dry season. In some localities the crops promise to be much better than the average. With winter corn the chief determining factor would appear to be soil condition. Fortunately, the autumn of 1937 was favourable to obtaining good cultural conditions at sowing time, and in most districts the weather during the winter months did not have a very damaging effect. As a result crops were in a good state to commence spring growth, and this, together with good soil conditions, favoured root development and enabled the crops to make good growth in spite of an abnormally dry season. Most of the disappointing results amongst winter corn crops can be traced to poor cultural conditions.

So far as spring corn is concerned, provided there was sufficient moisture to give the crops a good start, satisfactory results

have been obtained. In the south, east and Midlands, harvest was commenced in most favourable circumstances. Standing crops and dry soil allow rapid progress to be made, and if the crop can be carted while the land is dry and without poaching by horses and wagons, cultivation for next season's crop can be more readily carried out.

The work of preparing for next season's crop is already progressing, and much ploughing has already been done. Fallows in the main are clean and in good order, while clover stubbles and corn stubbles for a second white crop are turning up well. It will be an advantage if the ploughed land has a little time to settle before getting a large amount of rain. It is often stated that wheat likes a stale furrow, and this is no doubt because freshly-ploughed land will carry a much greater amount of moisture in the loose surface soil than land that has been ploughed for some little time and become settled. Tillage operations, such as harrowing and sowing, on wet, newly-ploughed land put the soil out of condition to a much greater extent than is frequently realized. No doubt the good results obtained this season from the favourable soil conditions last autumn and winter will be an incentive to cereal growers to produce the best possible soil conditions for sowing wheat, barley and oats this autumn.

Bunt and *smut* are still too prevalent in our cereal crops. Seed grain should be dressed with a suitable preparation, particular care being taken to ensure that the dressing is thorough, since the non-dressing of even a small part of the grain may result in the appearance of disease. Disappointing results from seed dressings are more often due to lack of sufficient care in dressing the seed than to other causes.

Potatoes. Prices, good at the commencement of the season, have fallen away. It is perhaps still too early to forecast the crop, and although disease is reported at the time of writing, it does not appear to be as severe or as widespread as in some seasons.

Apart from the actual destruction and damage of the crop by disease, the subsequent loss from disease depends to a large extent on the condition of the tubers at lifting time. In a season like the present, when the crops have bulked rapidly late in the season, the tubers tend to be soft and watery. Such tubers, even if only slightly affected by disease, decompose very quickly in the clamp and affect others. Care should be

taken to remove diseased and soft tubers when clamping; and, to avoid damage by bruising, gentle handling is advisable.

While in normal years it is usually advisable to push on with the work of lifting as early as possible, it would be well this season to make sure that potatoes to be clamped are reasonably well matured. On stronger soils, late varieties are remaining green longer than usual, and the tops may go down because of climatic conditions rather than maturity.

The best lifting method is a subject frequently discussed. Many growers prefer the plough to the spinner, owing to the fact that the tubers are less likely to be damaged. On the stiffer soils, however, gathering after the plough is not such easy work and often takes more time, a disadvantage where large acreages have to be lifted with limited labour. Many makes of spinners do comparatively little damage to the tubers. The use of the tractor to draw the spinner sometimes results in the work being done at too fast a pace, and the risk of damage is increased.

Land Fertility. The disappointing returns obtained from grazing stock, both cattle and sheep, may not prove a great incentive to grassland farmers to spend money on fertilizers, but the assistance given in the purchase of both slag and lime will no doubt usually counterbalance this. Most of our grass land needs phosphates and will be likely to give an economic return for their application. It is well to ascertain the chief limiting factor, as it sometimes happens that the results from phosphates alone are disappointing, while excellent results are obtained when potash is used along with them. This is most often so with light soils.

While it is reasonably safe to generalize regarding phosphates, it would appear that to do so on the question of liming is more difficult. Undoubtedly, very large areas of grass land show a lime deficiency on analysis, but it is on more limited areas that a satisfactory economic return can be obtained from the application of lime. Farmers are strongly advised first to ascertain the state of their soil with reference to lime requirements, and then to examine the probability of an economic return, before embarking on any great expenditure on lime for grass land.

The County Agricultural Staffs can be of the greatest assistance to farmers in these matters. It does not always follow

that even on sour soils an economic return from the application of lime will be obtained on grass land. On arable land, however, there are few instances where an economic return is not obtained from lime if the land is acid.

Proper distribution of all fertilizers is most important. Moderate applications of lime, well distributed, may give better results than larger dressings badly distributed.

Artificial manures are excellent supplements to farmyard manure, but as substitutes not quite as good. It is always a cheering sight to the husbandman to see the dung carts at work and the bold heaps set near to each other on the stubbles. The proper care of dung after it is made is most important, as much of its value may be lost by careless handling. The urine contains the greater part of the nitrogen and potash, and should be conserved whenever possible. Well made heaps or middens help to conserve much of the valuable manurial constituents, and evenness of distribution by careful spreading results in a more uniform crop in the following years. The spreading of farmyard manure is an operation requiring as much care as any other operation on the farm.

Live Stock. The present month is a most important one as far as the dairy herd is concerned. There is a natural tendency for cows to fall off in yield at this season of the year. Careful attention to feeding is important, as the pasturage has not now the same feeding value, and efficient milking is necessary if the yield is not to fall. All experienced hand milkers know that milk is more difficult to get from the cows in the autumn than in the spring.

Prices for both beef and mutton are low, and have their effect on the trade for store cattle and sheep. Large numbers of sales of cattle and sheep take place this month. While cattle have undoubtedly suffered where grass has been short, it is remarkable how sheep have retained bloom and condition; especially is this so with lambs.

Roots will be a good crop on many farms, especially if we get some rain during this month. A plentiful supply of roots reduces the cost of winter sheep feeding. While it is true that excessive root feeding may be somewhat wasteful so far as protein and starch equivalent are concerned, when the root supply is in excess of the normal requirements it is usually more economical financially to feed a liberal allowance.

Young cattle for winter fattening which are in good con-

dition, such as suckled calves or forward young stores, are usually best brought into the yards early in the autumn. While they may look reasonably well out-of-doors, their well-being is frequently more apparent than real, as stock on autumn grass tend to grow more hair and look more bulky without a corresponding condition of flesh. Older cattle can frequently be left out-of-doors for a longer period, although, generally speaking, all stock for winter fattening in yards do better if brought in in good time. The amount of winter keep and available accommodation are factors that have to be considered in planning the winter feeding programme.

AGRICULTURAL MACHINERY TOPICS

S. J. Wright, M.A.,
Director, Institute for Research in Agricultural Engineering, Oxford

Home-made Tractors. To judge from enquiries on the subject, considerable numbers of old high-powered cars are being converted into tractors for use in the lighter farm operations. In making such a conversion the first essential is to raise the gear ratio so as to reduce the road speed corresponding to any given engine speed to, say, one-third of the original value. A still greater reduction of speed would be desirable if it were not for the danger of placing too great a strain on the transmission and the difficulties of getting sufficient wheel grip. In this connexion it should be remembered that one cannot assume that a 20 h.p. car, after conversion, will be able to tackle anything like the work that a tractor of the same nominal power would ordinarily do. In effect, a motor car develops its greatest power by transmitting a small load at high speed, while a tractor does just the opposite, transmitting a heavy load at relatively low speed. And this essential difference applies not only to the car or tractor as a whole but to every part of the transmission. It follows, therefore, that, if possible, the necessary speed reduction should be done in such a way that the original components of the car transmission continue to run at something like their ordinary speed. In other words it is better to use a final chain drive than to put in a second gear box at some earlier stage of the transmission. The usual method is to mount a dead axle 2 or 3 feet in front of the existing back axle and to provide it with suitable bearings to carry the new rear wheels. The latter are fitted with large diameter chain sprockets driven by separate chain drives from smaller sprockets mounted (in place of the original rear wheels) on each half shaft. This method of conversion has three advantages: the final chain drive can be made more than heavy enough to transmit a useful drawbar load; the dead axle can be mounted above the main chassis member so as to allow larger diameter rear wheels to be used without giving the whole vehicle an undesirable cant forward; while the arrangement automatically shortens the wheelbase. The disadvantage is that the final chain drive is difficult to protect from dirt.

In order to give adequate adhesion, extra weight must be added—rather forward of the new back axle so as to obviate steering difficulties—and something better than the original rear wheels must be provided. These may be old large-diameter lorry wheels with pneumatic tyres, or specially-made open-pattern steel wheels with lugs. Since the home-made tractor will still have a relatively high speed the pneumatic-tyred lorry wheels will probably be preferable.

Running Costs. Whether the performance of the home-made tractor will be good enough to justify the trouble and expense of conversion is another matter. Starting with a standard 20 h.p. car, one would be fairly well satisfied to produce, at a total cost of say £40, a tractor capable of developing a steady 8 drawbar horse-power. The probable performance can be roughly compared with that of an ordinary small cheap tractor, costing £160 or so, and capable of developing 12 h.p., by noting that with the latter the overall running cost per hour will be made up of three more or less equal items: depreciation and repairs; fuel and oil; and labour. With sufficient accuracy for the present purpose we can assume that for the £160 tractor each of these items will amount to about one shilling per hour: an overall cost of 3*s.* per hour of running time. Then, omitting repair costs (which cannot in any event be estimated for the converted tractor) we may assume that overhead charges will be proportional to first cost, and that labour will cost the same for both machines. This gives, for the converted tractor, an overall cost of 1*s.* 3*d.* per hour, plus the cost of fuel for an hour of running time in which it cannot be expected to do more than two-thirds of the work which would be done in the same time by the more powerful ordinary machine. Working this out, we find that unless its fuel costs are as low as 9*d.* per hour the converted machine will be relatively uneconomical. Alternatively, it might be argued that this comparison is not fair since in practice the converted machine would be used mainly for the odd jobs which require only 8 h.p. and in which the ordinary tractor could not be fully loaded. If we take the latter view we can, in theory, afford to spend 1*s.* 9*d.* per hour on fuel for the converted machine.

Actually, however, we cannot expect the converted machine to burn less than 2 gal. of fuel per hour under farm conditions; and whether this will cost more or less than 1*s.* 9*d.* an hour

will depend entirely on what the fuel is. If the original car is a British-made one it will probably object to the slightest admixture of paraffin or vaporizing oil in its fuel; if it is an American one, on the other hand, it may operate reasonably well on a 50-50 mixture of petrol and vaporizing oil. In either case, attempts to make the converted machine run on vaporizing oil alone—by rigging up some form of manifold heating—are likely to result in the engine running itself to pieces in a very short time.

On the whole the conversion is not likely to be a very economical proposition and the most profitable outlet for old cars in agriculture would appear to be for use in jobs like hay-sweeping which they can tackle without any modification at all.

Sugar-Beet Harvesting. By the time these Notes appear the start of the sugar-beet harvest will be drawing near, and, with the problem of obtaining sufficient hand labour becoming ever more difficult, discussion about the possibilities of mechanical harvesting will, no doubt, be renewed. Many people seem to expect that, one day, an inventor will suddenly produce a beet harvester, altogether better than anything that has yet appeared, and that its immediate success will be assured. If anything of the kind does happen the harvester concerned will be the first agricultural appliance to be produced in this way: every other implement on record has been evolved by years of patient effort, starting from an indifferent first model and producing one slightly more successful effort after another on the way. In point of fact it is reasonably certain that the beet harvesting problem will not be solved by any sudden brain-wave. On the other hand it is equally certain that by a process of natural development the efficient harvester will eventually appear—provided that we are prepared to wait long enough for it. And here—in the particular case of sugar-beet—would seem to lie the difficulty; for while there was never any fear that the wheat crop might come to an end for want of a reaping machine, it is rather more possible that labour difficulties, and the lack of appropriate machinery, may bring sugar-beet growing in this country to a standstill.

This is hardly the place to discuss the steps that might be taken to accelerate progress, although two points which would undoubtedly be helpful may be mentioned. The first is that, since the final stages of development must in any event rest

with the implement trade, some assurance of a demand for the finished product is essential. The final cost of the machine can hardy be less than £150, and, until manufacture in quantity is possible, the cost will in all probability be appreciably more. Moreover, the number of sugar-beet growers who could justify, in any circumstances, the purchase of such a high-priced special-purpose implement is very limited. Eventually, therefore, the ultimate success of the project must depend on some kind of co-operative working or factory-ownership of equipment. If this fact were publicly recognized by the sugar-beet industry and some preliminary consideration given to the possibility of making suitable arrangements, the interest of the machinery trade would most certainly be stimulated. The other point is that we must adopt a rather more tolerant attitude in judging the performance of existing harvesters. The first machines on the market cannot be expected to be anything like perfect, if only because until *some* machines are sold both the stimulus and the practical evidence necessary for the final stages of development will be lacking. Somebody, therefore, must be prepared to take a chance on the still-rather-experimental first editions.

Several beet harvesters are already available, and some of them, at any rate, are worthy of serious attention in the light of the above remarks. They fall into three classes: machines which depend on the beet first being topped by hand in the ground; machines which themselves top the beet and then lift them; and machines which first lift the beet and then top them. Reasonably successful machines of the first two types have already worked experimentally in this country. The main defects were in topping, although, so far as the writer is aware, no serious attempt was made to find out (*a*) whether the mechanical topping was really appreciably worse than *average* hand topping, and (*b*) whether, if it was worse, the labour- and cost-saving advantages of the machine may not have been sufficient to offset losses due to indifferent topping. The only machine which tops after lifting hails from America and is said to be quite remarkably efficient. It would, however, cost appreciably more than the other types. Most existing machines dump the roots in heaps after lifting, but some experimental harvesters have included cleaning and loading mechanisms, and there would seem to be no reason why any machine which was successful at topping and lifting should not be adapted also to carry out these final operations.

NOTES ON FEEDING

CHARLES CROWTHER, M.A., Ph.D.,
Harper Adams Agricultural College

The Measurement of Food Values. It is a fundamental axiom of the science of animal nutrition that, apart from the oxygen taken in from the air through the lungs, the food-supply forms the only source from which the varied requirements of the animal can be met. The most careful tests have failed to reveal any indication of the possession by the living animal of any mysterious power of "making something out of nothing." If an exact record is compiled of the total intake of the animal, and, similarly, of the total output (including everything that may have been retained in the body), the two totals will agree within the limits of error of the most precise method of experiment that has yet been devised.

Clearly, therefore, the difference between the results obtained from equal amounts of two foods used under the same conditions must be sought in the composition of the foods, all of which are mixtures in varying proportions of water, organic matter and mineral matter. Water is a simple chemical compound, the same in all foods, so that any influence it may have in determining differences of nutritive effects is purely a matter of the quantity supplied. Given equal quantities of water, therefore, the difference between two foods is determined by differences in the composition of the "dry matter," that is, of the organic and mineral matters. In all materials used as food for animals each of these is a very complicated mixture of chemical compounds.

In the organic matter, the greater part, though by no means the whole, of the chemical compounds of which it is made up, fall into the three chemical categories (or "families") of proteins, oils (or fats), and carbohydrates. These together form so large a proportion of the food supply that they must clearly be regarded as the main reservoir out of which the requirements of the animal have to be met. Before they can serve the purposes of the animal, however, these ingredients have to undergo changes in the processes of digestion and assimilation, and for the efficient working of some of the most vitally important of these processes the co-operation of small quantities of other materials from the food (e.g., vitamins and minerals) is essential. Without these accessory factors the animal is rather like the motor-car engine with an abundant supply of petrol but no sparking device. The petrol is unques-

tionably the " food " of the engine, but it is useless without the accessory devices requisite to liberate and apply its stored-up energy.

Similarly, since the animal body contains various mineral elements, some of which are continuously being removed from the body in consequence of the vital activities, it is obvious that the food must provide the necessary minerals at least to make good these losses. Certain minerals are required furthermore to ensure the efficiency of various important activities of the body which are not necessarily associated with these losses, such as the development and sound functioning of the bones.

There are also other factors that contribute to the ultimate nutritive effect of a ration, such as palatability and the physical character (e.g., bulk) of the ration, so that clearly nutritive value is the resultant of the interaction of a considerable number of factors, and any method of assessing food values which attempted to cover all these factors would be far too complicated to apply in the everyday routine of feeding on the farm. Much criticism of the methods of measuring food values that are commonly used loses its point if this simple fact is recognized. " A method may be distinctly useful, although it may not be perfect, particularly in a field in which perfection is an unattainable ideal. . . . The practical problem is to select the most useful measure in terms of present developments." (Maynard).

Having in mind this limited aim, scientific opinion is unanimous that the best single measure of food values is that furnished by the energy-content of the food, which is derived almost entirely from the carbohydrates, fats and proteins.

Every ingredient of the organic matter of foods contains a store of energy, as is demonstrated by the heat-energy obtainable from it in the process of burning. Similarly every ingredient of the organic matter of the animal body and of animal produce (milk, eggs, etc.) contains its characteristic store of locked-up energy; whilst even more obviously a great part of the vital needs of the body, such as those for muscular exertion of all kinds and for the maintenance of the body temperature, are direct requirements for energy that have to be met from the food. In large part, therefore, the business of nutrition consists of a transformation of food energy into other forms of energy, and since energy can neither be created nor destroyed it is possible to get out balance sheets indicating

how the energy of different rations has been utilized by the animal.

Heat energy is very easily measureable, and therefore, it is convenient to express quantities of energy in terms of heat units. In scientific work the unit of heat used is designated a *calorie* and is the amount of heat required to raise the temperature of one gramme weight of water by 1° Centigrade. This is a very small unit, and for the study of farm feeding problems it is more convenient to use a unit 1,000 times greater, which is referred to as the *large Calorie,* and usually written with the large capital to avoid confusion with the scientific unit or small calorie.

The energy content of a food can easily be determined by burning a weighed quantity of it and measuring the amount of heat evolved. From this must be subtracted, however, that part of the heat which comes from the burning of the indigestible matters of the food, since clearly only the energy from the digestible materials can be utilized by the animal. Even this is not entirely available for nutritional purposes, since a small proportion of it comes away unused in the urine and in the form of combustible gases produced by fermentation.

Of the gross energy utilized by the animal ("available energy") a considerable proportion is liberated directly as heat to maintain the body temperature; a further proportion serves to provide for the internal work of the body (work of mastication, digestion, etc.) and appears eventually also as heat; and only such fraction of the available energy as remains after these needs have been met can serve the purposes of production, including the replacement of materials removed by "wear and tear" of the bodily organs and tissues. This last fraction of the energy, which serves "productive" needs, is commonly referred to as the "net energy" of the food.

From this outline of the utilization of the energy it will be seen that the "available energy" of the digested nutrients represents the gross energy value of the food for all purposes, including "maintenance," whilst the "net energy" represents the energy value of the food for productive purposes. In practice, the greater significance is naturally attached to the latter purpose, and therefore modern methods of comparing food values are based upon "net energy" values rather than upon the "available energy" values. The latter are the easier to determine and are probably more accurate than the corresponding "net energy" data, and in comparing two

foods of similar character the "available energy" basis might well be taken, since the ratio of net to available energy will be much the same for both foods. Where the foods differ widely in character, however, and especially with regard to the amount and toughness of the "fibre" present, the validity of comparisons on the available energy basis becomes increasingly doubtful, and the net energy basis gives results more in accord with practical experience.

The familiar "starch equivalent" method of comparing food values now in common use in this country is really based upon net energy values, but for the convenience of the plain man, who is more familiar with starch than with Calories, the latter are expressed in terms of equivalent weights of starch, one pound of pure starch being equivalent to 1,073 Calories of net energy. The method used for the assessment of these "starch equivalents" was devised by Kellner from his experimental measurements of the utilization of the energy of different foods by fattening oxen, and is based upon the formula:—

$$\text{S.E. \%} = [(\text{Dig Protein \%} \times 0{\cdot}94) + (\text{Dig. Oil \%} \times 2{\cdot}41)^{*} + \text{Dig Carboh' \%} + \text{Dig Fibre \%}] \times \frac{V}{100}$$

V being a correction factor necessary to bring the calculated value into line with that found by actual experiment. These factors are given in Column 14 of the Tables in *Rations for Live Stock* (Bulletin No. 48†).

The introduction of this method has undoubtedly effected a considerable improvement in our estimates of comparative food values, but it must be clearly realized that they are still far from precise and represent no more than closer approximations than were possible with the older methods. Some of the uncertainties attaching to them are discussed below.

LIMITATIONS OF STARCH EQUIVALENTS. (1) In the first place, the above formula represents the average results from experiments with relatively few oxen, showing appreciable individual variations. Thus, in four experiments carried out by Kellner with three oxen the individual results for the starch equivalent of dried sugar-beet pulp ranged from 54.6 to 58.4 per cent., whilst the correction (V) factors ranged from 71.6 to 81.1 per cent. In similar experiments carried out by

* The factor by which the oil is multiplied varies a little according to the class of food.

† Bulletin No. 48. *Rations for Live Stock*. By Dr H. E. Woodman. Price 1*s*. (by post 1*s* 2*d*) from H M. Stationery Office.

Fingerling with 7 pigs the starch equivalent results ranged from 66.9 to 71.6 per cent., and the V factor from 89.4 to 108.9 per cent. With such a range of individual variation it is obvious that no high order of accuracy can be attached to the average values unless the number of animals used is much larger than has yet been possible in this kind of experiment.

(2) Kellner's results were based entirely upon experiments with oxen. From the example quoted above it will be seen that very different results may be given by other classes of live stock.

In advisory work on rationing we are less often concerned, however, with the *absolute* production values than with the *relative* values of foods, and provided the digestive powers of two classes of animals for a given range of foods are approximately equal, it is probable that the *relative* production values of the foods will be much the same for each class of live stock. Such assumption at any rate is our warrant for applying to other classes of fattening live stock the Kellner starch equivalents that were derived exclusively from data on fattening oxen. Practical advisory experience and the evidence of feeding experiments has strengthened the belief that the Kellner starch equivalents furnish a sufficiently reliable basis for a rough control of the rationing of *fattening* live stock of all classes, and incidentally also of assessing food requirements for the production of work in the case of the ox or horse.

(3) Much greater uncertainty attaches to the use of the Kellner starch equivalents as measures of the relative values of foods for forms of production other than fattening (and work production), such as growth, milk production and egg production. In each of these forms of production protein plays a dominant rôle, whereas, as may be noted in the formula given above, it is barely equal to starch as a producer of fat. For these forms of production the protein is undoubtedly under-valued in the Kellner formula, but the problem is too complicated to admit of any accurate adjustment of the value of the protein by any simple modification of the formula. For the special case of milk production Hansson has drawn up a separate table of starch equivalents based upon the Kellner formula, but crediting the protein with its full energy value, which is 1.43 times that of starch. This certainly appears to give values more closely in accordance with practical experience in milk production than the ordinary Kellner starch equivalents, and might perhaps be rather more

suitable also for application to growth and egg production, in which the influence of protein supply also looms large, but at best it can be no more than a crude device for effecting some little improvement in our estimates.

Apart from the protein difficulty, there is the further complication that the relative efficiency of utilization of food energy in general varies with the form of production in the same class of animal. Thus, in experiments with cattle at the Pennsylvania Institute of Animal Nutrition it was found that, as compared with the efficiency of utilization for maintenance purposes taken as 1,000, the relative efficiencies for milk production and for fat production were 985 and 761 respectively.

(4) Since the calculation of starch equivalents is based upon the percentages of digestible nutrients the results are bound to be affected by any change in digestibility. Up to moderate levels of food supply the digestibility of rations by any one class of animal usually remains fairly constant, but at higher levels there is a steady tendency for the digestibility, and therefore the starch equivalent, to fall. At these higher levels, moreover, the efficiency of utilization of the digested energy also tends to fall, whereby the starch equivalent is depressed still further. The starch equivalent of a given mixture of foods cannot therefore be regarded as a fixed criterion, but will vary according to the amount of the mixture that is consumed. As production, and therefore food supply, rises above moderate levels the starch equivalents given in the tables for average conditions should be gradually reduced.

(5) Apart from the factors already discussed the starch equivalent of a ration varies according to its constitution, and particularly according to the "balance" of the individual nutrients. The ideal "balanced ration" for a particular purpose is one which supplies all the nutrients required for the optimum activity of the body function in question in adequate amount and quality, and in such relations to each other that there is no excess of any nutrient, or of the ration as a whole, large enough to interfere with physiological efficiency. This does not necessarily imply that all of the essential nutrients must be present in certain fixed proportions, but there may be a certain range between a minimum optimum and a maximum optimum level within which the proportion of a given nutrient may vary without appreciably affecting the balance.

There is evidence that the more nearly balanced the ration

the smaller will be the proportion of its energy that will be dissipated as heat and consequently the greater its net energy value or starch equivalent. A deficiency of one nutrient impairs the efficiency of all others, just as a defect in a minor part of any other complex mechanism will usually reduce the efficiency of the whole.

This influence of "balance" has the further effect of making it doubtful whether the total net-energy value of a ration can be arrived at, as is commonly assumed, by adding together the separately ascertained net-energy values of the individual feeding-stuffs of which the ration is composed.

From the considerations outlined above, it is clear that net-energy values (or starch equivalents) have their most nearly exact meaning when they are determined for the ration as a whole which is completely balanced for the body function in question. But our knowledge is still too imperfect to decide what is a completely balanced ration having regard to all the qualities that may be concerned with "completeness." Moreover it is clearly impossible to make direct experimental determinations of all the balanced rations that find use in practice.

These difficulties that arise in the application of the net-energy system to the assessment of nutritive values in practice have led American workers to the view that for the time being the only practicable method is to base the assessment on the available energy ("total digestible nutrients") rather than upon net energy. "While no measure can be considered a constant, net energy, which is clearly the most nearly exact measure of useful nutritive energy for a stated feed or ration, condition or function, becomes by its very exactness for specified conditions the more difficult to apply as a workable measure to the varied conditions of practice. . . . .These various considerations lead to the conclusion that the net-energy system does not at present provide a suitable measure of total nutritive energy for practice, though it remains a promising field for further study." (Maynard.)

This conclusion is perhaps unduly pessimistic, since the reversion to the "digestible nutrients" basis merely avoids one set of difficulties and creates another. It is essentially the method that was used before the introduction of the starch-equivalent basis, and despite the imperfections of the latter, it can hardly be questioned that its general adoption for the control of farm feeding has led to great improvement in the

reliability of advisory work and in the development of greater efficiency in farm practice. Although the starch equivalent is admittedly a far more variable criterion of production value than many who use it assume it to be, it still remains the best practical estimate we can form from the composition of the food. We must recognize its imperfections and try to reduce them, but it can never be more than a rough guide, often requiring intelligent adjustment to varying conditions, and offering its chief advantage over other methods when we are comparing foodstuffs of widely differing nutritive character.

FARMING OVERSEAS

Farming in South Africa: *Natal.* The attractive July, 1938, issue of *Farming in South Africa*—the official journal of the Union's Agricultural Department—has a more than usual interest for English readers. A leading article on agricultural problems and possibilities discusses farming in Natal where a diverse agricultural production is carried on in three main districts:— (*a*) the coastal belt with its sugar industry, (*b*) the midlands in which the black wattle is produced, and (*c*) the higher altitudes where general farming is practised. Shortage of agricultural labour is now becoming a serious problem, and some reorganization of agriculture in Natal is seen to be necessary as a way of meeting the difficulty. What methods are suggested? Mechanization within limits—if the right types of machines and implements are introduced to meet local conditions. One of the most important crops, e.g., grass, is in large measure harvested through the mouths of animals, but there is a summer surplus, often wasted, for the conservation of which better measures should be taken. Silage and hays are capable of being produced, harvested and stored with less labour than many crops grown in Natal to-day. "Increased applications of fertilizers per unit of area will lessen the labour involved, reduce the costs and increase the profits because the law of increasing returns still operates in many cases." The policy of selling grain from the farms, it is suggested, should be abandoned, and the grain fed to stock, which in time will supply the farms through the manure with the means of maintaining fertility. Sourveld (i.e., sour or acid pasture) should be laid down to better pasture which will carry an increased head of stock and stock of better quality. "In this direction lies the greatest prospect of improvement at the present time," coupled with the need for further investigation and trials with different strains of grasses. Following upon this must come the building up of better strains of live stock.

Soil Erosion. Another problem of agriculture in the Union finds expression in an informative series of articles on soil erosion which concludes with this issue of the Union's

Journal. In the districts where soil erosion presents the most serious features it is seen that the veld is overgrazed and the bare dry state of the ground does not lend itself readily to absorbing the heavy rains when they occur. The result is that the soil is simply washed away. The problem therefore is to find some convenient way of reducing the run off of rainwater. To this end the construction of contour banks is suggested, following the slope of the veld with a view to breaking the velocity of the run off and thus giving the soil more chance to absorb the water. This work, however, is as yet only in the experimental stage. For other districts, e.g., where the slope of the ground is gentler and where soil erosion is not so serious, the use of flood waters brought down by rivers is recommended. Under this method the flood water is turned into suitable canals which enable the water to be carried along until it can be released, having lost much of its former velocity, and distributed more or less evenly over the veld. A third method seeks to prevent the veld from becoming worn and denuded by large numbers of beasts by the construction of more drinking dams and smaller paddocks.

Small Holdings. An ideal cherished by a great many people in South Africa is a sturdy substantial class of farmers, owning and tilling their own land. This ideal lies behind the " back to the land " movement which is being widely advocated, but the actual tendency is rather in the direction of a " drift from the land." Farmers' sons and daughters are not staying on the farms, and fewer of the younger generation are training for agriculture. The reason is that there is at least a doubt as to whether small holdings pay. " Wheat is invariably the main crop, followed by maize and a few acres of tobacco during the summer." But under the climate and farming conditions in South Africa, is wheat a profitable crop? And the position often gets progressively worse because of the exhaustion of the soil, especially in respect of humus. The picture is far from an attractive one, and lack of capital and lack of knowledge act effectively as limiting factors in retarding progress. More vegetables might certainly be grown, and generally a greater variety of crops would seem to be one way along which the problem could be tackled. Probably the best crop to grow in present conditions is lucerne—the risk of failure is not so great as it is in regard to wheat; the crop should be readily marketable to stock farmers or to dairymen in the

populous districts; and lucerne is a useful crop from the point of view of maintaining soil fertility.

"Lack of knowledge concerning intensive farming methods more than anything else, is the main cause of failure in small holdings." Sound systems of subsistence farming must, therefore, be devised and information about them must be brought within reach of the existing small holders. Finally, steps should be taken "to avoid the handing of some of our most valuable land, which demands the most intensive and intelligent husbandry, to people who are not likely to make a success of such a system of farming."

BACON INDUSTRY ACT, 1938

The Bacon Industry Act received the Royal Assent on July 29. The following is a brief summary of the principal provisions of the Act.*

Part I provides for the establishment of a new Bacon Development Board to supersede the Development Board set up by the Bacon Development Scheme, 1935, which automatically ceases to have effect. The new Bacon Development Board consists of thirteen persons, five appointed by the Minister of Agriculture and Fisheries and the Secretary of State for Scotland jointly, four nominated by the Pigs Marketing Board, and four nominated by the Bacon Marketing Board. The Development Board is given powers of control in all major matters of policy. The two marketing boards will act in accordance with directions given by the Development Board in all matters except those in which the Act specifically requires them to act independently. If either of the two marketing boards fails to comply with any such directions of the Development Board, or acts in a manner inconsistent with the policy of the Development Board, the functions of the marketing board concerned may, with the approval of Parliament, be transferred to the Development Board.

In the event of the Bacon Marketing Scheme being revoked, certain of the powers of the Bacon Marketing Board pass to a statutory Bacon Curers' Advisory Committee, and the remainder become vested in the Development Board. The same principle applies if the Pigs Marketing Scheme is revoked, certain powers in that case passing to such body of persons as the Minister and Secretary of State consider to be representative of registered pig producers.

The new Development Board may be wound up by a resolution of the Board. If the Board is wound up, the Pigs and Bacon Marketing Schemes are deemed to have been revoked, and the Bacon Industry Act ceases to have effect.

Part II provides the machinery for factory rationalization, the purpose of which is to increase the efficiency of the bacon industry by regulating the extent of the facilities for producing

* Copies are obtainable directly from H.M. Stationery Office, or through any bookseller, price 1s. 3d. net.

bacon. A factory rationalization scheme may be prepared by the industry, and must then be submitted to the Minister for the approval of Parliament, in much the same way as an agricultural marketing scheme under the Agricultural Marketing Act, 1931. A factory rationalization scheme may regulate the manner in which the powers of the Development Board are to be exercised, and may also provide for the revocation of factory licences on payment of compensation, and for the refusal of applications for, and the variation of, conditions of licences.

If a factory rationalization scheme is considered by registered bacon curers to be operating injuriously to the interests of persons engaged in the bacon industry, representations to that effect may be made, and the Committee of Investigation procedure then applies. Acting on a report by the Committee of Investigation, the Minister and the Secretary of State may, subject to the approval of Parliament, by order amend or revoke the scheme, or may direct the Development Board to exercise its powers in such manner as they may specify.

If, within a prescribed period, no factory rationalization scheme is in force or in course of preparation, or if at any time a scheme in force is revoked, the protection from internal competition given to curers under the Act, such as production and sales quotas and conditions governing the issue of licences (other than the conditions relating to hygiene), is automatically withdrawn.

Part III deals with the licensing of bacon factories and the revocation of licences. The powers of the Development Board in this respect are wide, and, as indicated above, may be extended by a factory rationalization scheme. Persons who do not produce more than 40 cwt. of bacon in eight consecutive weeks are exempted from the licensing provisions of the Act. Special provision is made for the licensing of curers who do not produce more than 60 cwt. of bacon in four consecutive weeks, and holders of these "small curers' licences" are not affected by any factory rationalization scheme. In addition to the statutory exemption referred to above, the Development Board may exempt from licensing any class of premises or any description of bacon.

Premises not exempted may not be used for the production of bacon except under and in accordance with licences granted by the Development Board.

Part IV deals with the system of the pig supply (including special provisions governing the first three contract periods, when subsidy payments are to be made). The principal method of the supply of pigs to registered curers is to be the long contract, i.e., a contract for a period of twelve months, but the Development Board may exempt from the long contract system such sales and purchases as may be specified in its determination. Thus the contract system will possess a greater degree of flexibility than hitherto. There are certain general exemptions: the long contract does not apply to sales and purchases of pigs not more than 16 weeks old, pigs not used for the production of bacon, and pigs sold for bacon purposes to exempted curers or holders of small curers' licences.

Long contracts are to be made in a prescribed form through the Pigs Marketing Board, and that Board, acting under the directions of the Development Board, will be responsible for the distribution amongst registered curers of all pigs offered on long contracts, according to a pre-determined system. Provision is made for producers who wish to sell pigs under the prescribed contracts to have the right to exercise certain options. A producer can nominate a particular curer as the person to whom he wishes his pigs to be sold; the pigs must then be sold to that person unless the Pigs Marketing Board exercises its right to transfer the pigs to another curer, in accordance with a statement which the Board is required to make and publish at the same time as the forms of contract are issued, embodying the circumstances (if any) in which it may so transfer pigs. If the pigs are transferred away from the nominated curer, a premium of 1*s*. per pig is payable, 6*d*. of which is retained by the producer and 6*d*. accrues to the nominated curer. Producers may sell on "open offer," i.e., without nominating any curer as the person to whom their pigs are to be sold, in which case they qualify for an "allocation premium" of an amount to be specified in the forms of contract. Producers also have the option of selling their pigs under a group contract, that is to say, they may combine so as to ensure that collectively they will be able to maintain regular contract deliveries. These group contracts will be treated as "open offer" contracts, and will attract the appropriate allocation premium. Provision is made also for persons who are both pig producers and bacon curers.

For the first three contract periods, registered curers will be

required to pay in respect of pigs delivered and accepted under long contract a standard price for a standard pig. This price is related to the cost of feeding stuffs; if in any month the ascertained cost of a standard ration, as determined by the Minister and the Secretary of State, exceeds 8*s*. 6*d*. per cwt., the curer is to pay the producer an additional sum at the rate of 10.3*d*. for every 1*s*. above 8*s*. 6*d*., and when the cost of the standard ration is below 8*s*. 6*d*. per cwt., there is to be a deduction at the same rate from the price of the pig. The curer recovers from or pays to the Exchequer the amounts added to or deducted from the price of the pig, provided that not less than a prescribed fraction of the pig is made into bacon: if less than the prescribed fraction is made into bacon, the amounts payable from or to the Exchequer are reduced *pro rata*.

A level of bacon prices is assumed for the purposes of the price of the standard pig: if actual ascertained prices of bacon are below that level the Exchequer is to make up the difference; if they are above, the curers are to pay the Exchequer.

In the first of the three years, the average standard pig price of 12*s*. 6*d*. per score is linked with a notional bacon price of 94*s*. 9*d*. per cwt.; in the second year there is to be a reduction to 12*s*. 5*d*. and 93*s*. 9*d*. respectively; while in the third year there is to be a further reduction to 12*s*. 3*d*. and 91*s*. 9*d*. respectively.

The maximum numbers of pigs that may be accepted on long contract are fixed at 2,100,000 in the first year, 2,400,000 in the second year, and 2,500,000 in the third year.

Part V empowers the Bacon Marketing Board, acting under the directions of the Development Board, to determine the quantities and descriptions of bacon that may be produced and sold by registered curers.

Part VI deals with miscellaneous and general matters. It continues the arrangements for the regulation of supplies of home-produced and imported bacon; sets out the manner in which Part IV is to apply to curers who produce pigs; applies the procedure of Consumers' Committees and Committees of Investigation to the powers exercised by the Development Board; deals with the grading and marking of carcasses, the contributions to the expenses of the Development Board and the Pigs and Bacon Marketing Boards, and the steps to be

taken by the Development Board in regard to research and education; substitutes the provisions of the Act for Part VI of the Pigs and Bacon Marketing Schemes, 1933; empowers the Bacon Marketing Board, acting under the directions of the Development Board, to determine that the expenses of transport of pigs on behalf of registered curers shall be pooled; applies the principle of fair wages to persons employed in the production of bacon; and defines various terms used in the Act.

The Schedules. The First Schedule contains the provisions with respect to the Development Board and its proceedings. The Second and Third Schedules deal with the functions and proceedings of the Bacon Curers' Advisory Committee. The Fourth Schedule provides for the winding-up of the Development Board, while the Fifth Schedule relates to the adaptations and modifications of the Pigs and Bacon Marketing Schemes (other than Part VI) consequent upon the new Act.

PERSONNEL OF THE NEW BACON DEVELOPMENT BOARD

The following are the members of the Bacon Development Board set up under the Bacon Industry Act:—

Appointed by the Minister of Agriculture and Fisheries and the Secretary of State for Scotland

The Lord Portal, M V O , D S.O , D L , J P (Chairman)
Sir James Ross, K.B E , C B (Vice-Chairman)
Sir Francis Boys, K B E.
Sir Nigel Campbell.
Leslie William Farrow, Esq , F C A

Nominated by the Pigs Marketing Board

Captain G Deakin
S. H. Eva, Esq
J. A. Fox, Esq.
J. H. Wain, Esq.

Nominated by the Bacon Marketing Board:

J. F. Bodinnar, Esq
J. Kirkpatrick, Esq.
H. Martin Lewis, Esq
G. F. Spear, Esq.

THE BACON INDUSTRY ACT (COMMENCEMENT) ORDER, 1938

The Bacon Industry Act provides that the Act shall come into force on such day as the Minister of Agriculture and Fisheries and the Secretary of State for Scotland, acting in conjunction, may appoint, and that different days may be appointed for different purposes and different provisions of the Act.

An Order* made on August 2 by the Minister and the Secretary of State brought into force on August 4 the principal provisions of the Act, except those relating to the regulation of sales and purchases of pigs for bacon production which will come into operation on October 1 next. The new Development Board, therefore, superseded on August 4 the board established under the Bacon Development Scheme. As from August 4 also, it became an offence, under the Act, to produce bacon on premises which are not licensed by the Development Board or exempted from the necessity of having a licence. In order, however, to give curers time to obtain new licences, the Development Board has exempted until October 1 premises which were licensed on July 29 under the old Development Scheme from the necessity of being licensed under the Act. Curers desiring further information on this point should communicate with the Secretary, Bacon Development Board, Thames House, Millbank, London, S.W.1.

The marketing provisions of the Pigs and Bacon Marketing Schemes will cease to have effect on October 1, when the new system of pig supply embodied in the Act will come into operation.

The Order fixes December 1, 1938, as the beginning of the first contract period under the Act. Between October 1 and December 1 sales and purchases of bacon pigs will be regulated under arrangements to be made by the Bacon Development Board. A further announcement on this subject will be made by that Board.

* The Bacon Industry Act (Commencement) Order, 1938 (S.R. and O. 1938, No 785), obtainable directly from H.M. Stationery Office or through any bookseller, price 1*d* net

MARKETING NOTES

Milk Marketing Scheme. The wholesale price for liquid milk (other than Tuberculin Tested milk) in July, 1938, was 1s. 5*d*. per gal., 4*d*. more than in July, 1937; the wholesale price for Tuberculin Tested milk in July, 1938, was 1s. 7*d*. per gal.

Pool prices for July, 1938, are given below, with comparative figures for June, 1938, and July, 1937.

	Pool Prices		
	July 1938 *d*	*June* 1938 *d*	*July* 1937 *d.*
Northern	12½	10¼	10
North-Western	12½	10¼	10
Eastern ..	13	10½	10½
East Midland	12¾	10½	10¼
West Midland	12¼	10	9¾
North Wales	12½	10	9¾
South Wales	12½	10¼	10
Southern..	13	10¾	10½
Mid-Western	12¼	10	9¾
Far-Western	12¼	10	9¾
South-Eastern	13¼	11	10¾
Unweighted Average	12·61	10 32	10·09

These prices are exclusive of any premium for special services and level deliveries, and also of the quality bonuses for Accredited and Tuberculin Tested milks. The estimated gallonage on which quality premiums have been earned was 41,148,163.

The inter-regional compensation levy was fixed at 2½*d*. per gal., compared with 1¼*d*. per gal. in July, 1937. Sales on wholesale contracts were as follows:—

	July, 1938 (*estimated*) *Gal.*	*July*, 1937 (*estimated*) *Gal*
Liquid	53,058,621	50,499,151
Manufacturing . . .	35,003,258	31,026,412
	8,061,879	81,525,563
Percentage liquid sales	60·25	61·94
Percentage manufacturing sales ..	39·75	38·06

The average realization price of manufacturing milk during July was 6.66*d*. per gal., compared with 5.71*d*. per gal. for

July, 1937. The quantity of milk manufactured into cheese on farms was 3,430,129 gal., compared with 3,511,509 gal. in the previous month and 2,995,614 gal. in July, 1937.

Potato Marketing Scheme. *Amendments.* The London hearings of the Public Inquiry into objections duly lodged with respect to the proposed amendments opened on July 11 and terminated on July 30. Arrangements have been made for the Scottish hearings to commence at the Scottish Land Court, 1, Grosvenor Crescent, Edinburgh, at 11 a.m., on Tuesday, September 20, 1938.

Riddle Regulations. On August 4, 1938, the Potato Marketing Board prescribed a new minimum riddle regulation, to come into operation forthwith, of 1½ in. for all varieties sold anywhere in Great Britain, with the exception of Kerr's Pink and Red Skin sold in Scotland, for which a minimum riddle of 2 in. was prescribed. These new regulations superseded all previous riddle regulations and will remain in force until a further determination is made by the Board.

Sale of "Seconds." The Board have also decided to permit the sale, by any registered producer in England and Wales, of "seconds" for human consumption, "seconds" being defined as sound, marketable potatoes which are capable of passing through a riddle of 1⅝ in. or less, but stand on a riddle of 1¼ in. Special labels, obtainable on application to the Board, must be used.

Wheat Act, 1932: *Appointment of Chairman of the Wheat Commission.* The Minister of Agriculture and Fisheries and the Secretaries of State for Scotland and for the Home Department have appointed the Rt. Hon. The Lord Harlech, P.C., G.C.M.G., to be Chairman of the Wheat Commission.

Sales of Home-Grown Wheat—Cereal Year 1937-38. Certificates lodged with the Wheat Commission by registered growers during the period August 1, 1937, to August 6, 1938, cover sales of 24,289,254 cwt. of millable wheat, as compared with 23,552,914½ cwt. in the corresponding period (to August 7) in the preceding cereal year.

New Wheat Commission Byelaw. The Minister of Agriculture and Fisheries and the Secretaries of State for Scotland

and the Home Department, in the exercise of the powers conferred upon them by Section 5 of the Wheat Act, 1932, have made the Wheat Commission (Approval of Byelaws) No. 12 Order, 1938, (S.R. & O., 1938, No. 722) approving the Wheat (Flour Mixtures) No. 2 Byelaw, 1938, made by the Wheat Commission. The purpose of this Byelaw is to bring within the scope of Wheat Byelaw 19 any mixture which is proved to the satisfaction of the Wheat Commission to have been delivered for consumption (whether after or without further manufacture) as animal or poultry food.

Copies of the Order can be obtained—price 1d net—from the Stationery Office or through any bookseller Copies of the Byelaw (price 1d. net) and of the Wheat Byelaws, 1932 (the latter price 6d., post free) may be obtained from the Wheat Commission, 10, Smith Square, London, S.W 1.

Ascertained Average Price of Home-Grown Millable Wheat in 1937-38. After consultation with the Wheat Commission, the Minister has made the Wheat (Ascertained Average Price) Order, 1938, (S. R. & O., 1938, No. 795) certifying and prescribing that, during the cereal year ended July 31, 1938, registered growers sold 24,550,000 cwt. of millable wheat of their own growing at an average price of 8*s*. 4.394*d*. per cwt.

Anticipated Supply for the Cereal Year, 1938-39, *and New Quota Payments Order.* The Minister (on the recommendation of the Wheat Commission) has made Orders giving an estimate of the supply of home-grown millable wheat in the cereal year 1938-39, and increasing the quota payment which every miller and every importer of flour is liable to make to the Wheat Commission in respect of each hundredweight of his output of flour. The Wheat (Anticipated Supply) No. 2 Order, 1938, estimates the quantity of home-grown millable wheat of their own growing that will be sold by registered growers during the cereal year 1938-39 at 30,500,000 cwt. By the Wheat (Quota Payments) No. 4 Order, 1938, the Minister has, in the light of estimates furnished by the Wheat Commission, prescribed that the quota payment in respect of deliveries of flour during the period beginning on August 11, 1938, shall be 16.8*d*. per cwt. (equivalent to 3*s*. 6*d*. per sack of 280 lb.). This Order supersedes the Wheat (Quota Payments) No. 3 Order, 1938, under which quota payments were fixed at 9.6*d*. per cwt. (equivalent to 2*s*. per sack of 280 lb.) as from April 10, 1938.

Copies of the present Orders—Statutory Rules and Orders, 1938, Nos. 776 and 777—can be obtained from H.M. Stationery Office, or through any bookseller, price 1d. each, post free 1½d.

Report on the Administration of the Wheat Act, 1932. The Wheat Commission, with the approval of the Ministers concerned, have prepared a report (Ministry of Agriculture and Fisheries Economic Series, No. 45) on the administration of the Wheat Act, 1932, during the period of a little over five years from the date of appointment of the Commission on June 1, 1932, to July 31, 1937. This Act provides for financial assistance and marketing security for wheat growers in the United Kingdom by a scheme which involves no charge on public funds, and the report deals in as brief a manner as possible, consistent with an adequate treatment of a somewhat novel type of legislation, with the objects of the Act, how it is administered, and the various problems with which the Commission have had to deal. The first two chapters describe the principle provisions of the Act and of the Byelaws made by the Commission; the third chapter records the methods, problems and results of administration; the fourth draws attention to certain interesting aspects of the operation of the Act; the fifth deals with the review of the standard price for wheat which took place during the period covered by the report; and the sixth relates to proposals for amending the Act in the light of experience gained since it came into force.

Copies of the report will be available on September 7, price 1*s* (1*s* 4*d*. post free), and may be obtained from His Majesty's Stationery Office, Kingsway, W C 2, or through any bookseller

National Mark Campaigns. A National Mark " Week " will be held at the Oxford Hall, Reading, during the period September 14-23.

Marketing Demonstrations. A comprehensive range of products, packed and graded to National Mark standards, will be staged by the Ministry at the London Grocer's Exhibition, Agricultural Hall, September 17-23, and at the Dairy Show, which this year is being held at Earls' Court, September 26-29.

A full range of the Ministry's publications will be on sale at each show.

Livestock Industry Act, 1937: *Cattle Fund.* The table below gives particulars of the operations of the Fund during the first four months of each of the last three years:—

	Payments	*Animals covered by Payments*	*Average Payment per Animal.*
April—July 1936	£1,276,892	548,406	£2 6 7
,, ,, 1937 ..	£1,266,198	542,112	£2 6 9
,, ,, 1938 ..	£1,300,188	470,443	£2 15 3

Proportions of Animals Certified at Different Subsidy Rates. Under the scheme which came into force under the Livestock Industry Act on August 1, 1937, subsidy is payable at varying rates. The table below brings up to the latest date available the information on this subject which was tabulated in the JOURNAL for June, 1938:—

	Total No of Cattle Certified	Home Bred		Imported	
		Ordinary Standard	Quality Standard	Ordinary Standard	Quality Standard
August, 1937—June, 1938—					
England ..	902,957	370,735	285,743	109,427	137,052
„ (per cent)		41·0	31·8	12·1	15·1
Wales	65,939	48,861	14,379	1,791	908
„ (per cent)		74·1	21·8	2·7	1·4
Scotland	304,203	38,324	155,772	12,497	97,610
„ (per cent.)		12·6	51·2	4·1	32 1
N. Ireland	89,612	71,111	9,906	7,198	1,397
„ (per cent)		79·4	11·0	8·0	1·6
United Kingdom ..	1,362,711	529,031	465,800	130,913	236,967
„ (per cent)		38·8	34·2	9·6	17·4
June, 1938—					
England	72,500	23,430	28,727	6,780	13,563
„ (per cent)		32·3	39·7	9·3	18·7
Wales	2,905	1,792	1,032	23	58
„ (per cent.)		61·7	35·5	0 8	2 0
Scotland	27,830	2,134	14,184	1,061	10,451
„ (per cent)		7·6	50·9	3·9	37 6
N. Ireland	6,173	4,566	1,149	306	152
„ (per cent)		74·0	18·6	4·9	2·5
United Kingdom .	109,408	31,922	45,092	8,170	24,224
„ (per cent.)		29·2	41·2	7·4	22·2

Approval Orders under Section 14. The Livestock Commission, with the approval of the Minister, have recently made two further orders under Section 14 of the Act, approving the premises known as the Uttoxeter Cattle Market at Uttoxeter, Staffordshire, and the Seamer Junction Auction Mart, at Seamer, Yorks, N.R., respectively, for use as livestock markets. The markets have recently been extended to include premises that were not used for the purposes of a livestock market during the year ended November 30, 1936.

AGRICULTURAL RETURNS OF ENGLAND AND WALES, 1938

ACREAGE UNDER CROPS AND GRASS AND NUMBERS OF LIVE STOCK ON HOLDINGS ABOVE ONE ACRE IN EXTENT IN ENGLAND AND WALES AS RETURNED BY OCCUPIERS ON JUNE 4, 1938

(*The figures for* 1938 *are subject to revision*).

Crops and Grass

Distribution	1938	1937	Increase		Decrease	
	Acres	*Acres*	*Acres*	*Per cent*	*Acres*	*Per cent*
TOTAL ACREAGE under all CROPS and GRASS	24,695,000	24,780,000	—	—	85,000	0·3
ROUGH GRAZINGS*	5,440,000	5,442,000	-	—	2,000	—
ARABLE LAND	8,872,000	9,024,000		-	152,000	1·7
PERMANENT GRASS						
For Hay	4,225,000	4,675,000	—	--	450,000	9·6
Not for Hay	11,598,000	11,081,000	517,000	4·7	—	—
TOTAL	15,823,000	15,756,000	67,000	0·4	—	—
Wheat	1,829,000	1,731,000	98,000	5·7	—	—
Barley	886,000	823,000	63,000	7·7	—	—
Oats	1,299,000	1,223,000	76,000	6·2	—	—
Mixed Corn	92,700	92,400	300	0·3	—	—
Rye	18,700	16,000	2,700	16·9	—	—
Beans, for stock feeding or seed	129,600	97,000	32,600	33·6	—	—
Beans, for market or canning	15,200	13,200	2,000	15·2	—	—
Peas, for stock feeding or seed	38,300	35,000	3,300	9·4	--	—
Peas, for canning or packeting, green or dried	29,000	25,100	3,900	15·5	—	—
Green Peas, for market	57,400	45,600	11,800	25·9	—	—
Potatoes, first earlies	58,500	55,200	3,300	6·0	-	—
Potatoes, main crop, including second earlies	416,100	400,100	16,000	4·0	—	—
Turnips and Swedes for stock feeding or seed	405,800	425,800	—	—	20,000	4·7
Turnips and Swedes, for human consumption	17,900	14,700	3,200	21·8	—	—
Mangolds	213,300	207,000	6,300	3·0	—	—
Sugar-beet	328,500	306,600	21,900	7·1	--	—
Kohl Rabi	5,400	6,200	—	—	800	12·9
Rape (or Cole)	54,400	55,800	—	—	1,400	2·5
Cabbage, Savoys and Kale for fodder	92,500	84,500	8,000	9·5	—	—
Cabbage, Savoys, Green Kale and Sprouting Broccoli, for human consumption	43,200	38,200	5,000	13·1	—	—
Brussels Sprouts	41,300	32,500	8,800	27·1	—	—
Cauliflower or Broccoli (non-sprouting)	19,900	18,800	1,100	5·9	—	—
Vetches or Tares	49,100	38,400	10,700	27·9	—	—
Lucerne	31,200	34,900	—	—	3,700	10·6
Carrots	15,600	13,900	1,700	12·2	—	—
Onions	2,000	1,700	300	17·6	—	—

* Mountain, Heath, Moor, Down and other rough land used for grazing.

Distribution	1938	1937	Increase		Decrease	
	Acres	*Acres*	*Acres*	*Per cent*	*Acres*	*Per cent.*
Mustard for seed	23,700	24,100	—	—	400	1·7
Hops	18,500	18,100	400	2 2	—	—
Small Fruit	50,400	52,100	—	—	1,700	3·3
Orchards	250,700	258,600	—	—	7,900	3·1
CLOVER AND ROTATION GRASSES.						
For Hay	1,185,000	1,470,000	—	—	285,000	19·4
Not for Hay	715,000	751,000	—	—	36,000	4·8
TOTAL .	1,900,000	2,221,000	—	—	321,000	14·5
BARE FALLOW	351,300	534,800	—	—	183,500	34·3

The returns made on June 4, 1938, by occupiers of agricultural holdings exceeding one acre in extent in England and Wales relate to 30,135,000 acres of agricultural land as compared with 30,222,000 acres in 1937, a net reduction of 87,000 acres or 0·3 per cent The area under crops and grass was 24,695,000 acres, a decrease of 85,000 acres or 0·3 per cent, and the total area of rough grazings, including those held in common, at 5,440,000 acres, fell contrary to the usual trend by 2,000 acres The arable area has continued to decline, the total this year at 8,872,000 acres showing a decrease of 152,000 acres or 1·7 per cent, compared with the acreage in 1937. Practically all corn and root crops have increased in acreage but there have been decreases in clover and rotation grasses (321,000 acres or 14·5 per cent) and bare fallow (183,500 acres or 34·3 per cent.) The area of bare fallow in 1937 was unusually large Among the remaining crops, turnips and swedes for stock feeding decreased by 20,000 acres (4 7 per cent) and lucerne by 3,700 acres (10·6 per cent.), while an area of 67,000 acres was added to permanent grass

Cereals An increased area of 98,000 acres or 5·7 per cent. was returned as under wheat, the total being 1,829,000 acres as compared with 1,731,000 acres in 1937 This is the largest acreage of wheat recorded since the year 1922 The acreage under barley again showed an increase from 823,000 acres in 1937 to 886,000 acres, an addition of 63,000 acres or 7·7 per cent. The large decrease recorded in the oat acreage in 1937 was partly recovered this year, the acreage having risen from 1,223,000 acres to 1,299,000 acres, an increase of 76,000 acres or 6·2 per cent The areas under mixed corn and rye also showed increases of 300 acres and 2,700 acres respectively.

Beans and Peas The areas under all categories of beans and peas were appreciably larger, the chief increases being in beans for stock-feeding or seed and green peas for market, the acreages of which were increased by 32,600 acres (33·6 per cent) and 11,800 acres (25·9 per cent.) respectively.

Potatoes. The annual decline recorded in the total potato acreage since 1933 was checked in 1938, when the area amounted to 58,500 acres of first earlies and 416,100 acres of main crop (including second earlies). The increases over 1937 were 3,300 acres (6·0 per cent) and 16,000 acres (4·0 per cent.) respectively. The acreage returned to the Ministry under potatoes includes all areas of ¼ acre and upwards on holdings of over 1 acre in extent, and is accordingly larger than the acreage returned to the Potato Marketing Board by registered growers.

Sugar-Beet. The acreage under sugar-beet increased from 306,600 acres in 1937 to 328,500 acres, a rise of 21,900 acres or 7·1 per cent.

Roots. All root crops, with the exception of turnips and swedes for stock-feeding or seed, which decreased by 20,000 acres or 4·7 per cent., were grown on larger areas than in 1937

Vegetables for Human Consumption. The various vegetable crops for human consumption all showed increases over the acreages in the previous year Cabbage, savoys, green kale and sprouting broccoli accounted for 43,200 acres, brussels sprouts for 41,300 acres and cauliflower and broccoli for 19,900 acres, these figures representing increases of 5,000, 8,800 and 1,100 acres respectively. The area returned under brussels sprouts is the largest recorded since the collection of this information was commenced in 1914.

Other Crops. The most important changes in other crops are the increases of 10,700 acres (27·9 per cent) in vetches or tares, and 8,000 acres (9·5 per cent) in cabbage, savoys and kale for fodder while the area under lucerne declined by 3,700 (10·6 per cent) and slight decreases are recorded in kohl rabi and rape

Fruit The areas devoted to orchard and small fruit again declined, the loss this year amounting to 7,900 acres (3·1 per cent) and 1,700 acres (3·3 per cent) respectively.

Clover and Rotation Grasses and Meadow Hay The season has been unfavourable for clover and rotation grasses and meadow hay. The area under rotation grasses for hay this year at 1,185,000 acres is the lowest ever recorded, while the acreage of meadow hay at 4,225,000 acres is, with the exception of the year 1919, the lowest since the year 1899 The decreases amount to 285,000 acres (19 4 per cent) and 450,000 acres (9·6 per cent) respectively

Live Stock

Cattle The total number of cattle increased on the year by 39,000 or 0·6 per cent The chief increase was in cattle under one year old of which there were 86,000 or 6·9 per cent more than in the previous year

Decreases occurred in cows in calf, but not in milk (22,200 or 5·6 per cent) and in cattle two years and above (33,200 or 3·3 per cent)

Sheep The items relating to sheep on the Agricultural Return were amended in 1938 in order to distinguish separately sheep over and under one year old, and to clarify the classification of two-tooth ewes (or shearlings) In the summary below the number of two-toothed ewes to be used for breeding in 1938 has been included with that of older ewes kept for breeding, and for this reason the apparent addition of 1,019,800 animals to the breeding flocks cannot be regarded as a true indication of the change that has occurred in the past twelve months. The total figure of 8,340,300 should, however, afford a better guide than in previous years to the prospective breeding capacity of the sheep flocks of the country. The total number of sheep returned on June 4 increased by 373,900 (2·2 per cent) from 17,194,200 to 17,568,100

Pigs. The total number of pigs declined by 86,300 or 2·4 per cent. Pigs under two months old decreased by 157,900 or 15·2 per cent, although pigs over two months old increased by 95,300 or 4·5 per cent.

Horses. The steady decline in horses since 1918 was continued in 1938, when the total number of all kinds on agricultural holdings was further reduced by 9,000 or 1·0 per cent The reduction was chiefly in "other horses" of which there were 16,100 less than in the previous year, but unbroken horses of one year old and above increased by 5,200, and there was also a small increase in the numbers used for agricultural purposes.

Poultry. The decline in the total number of fowls that has been in evidence since 1934 was practically arrested this year, the decrease of 1,595,000 in the number of fowls over six months old being almost offset

by the gain in the number of young birds of 1,156,000 with the result that the net reduction in the fowl population was the insignificant figure of 439,000 or 0·8 per cent. All other classes of poultry showed a rise in numbers, that for turkeys being no less than 105,000 (15·4 per cent.).

	1938	1937	Increase		Decrease	
	No	*No*	*No*	*Per Cent*	*No.*	*Per Cent.*
Cows and Heifers in milk	2,219,200	2,217,400	1,800	0·1	—	--
Cows in Calf, but not in milk	372,200	394,400	—	—	22,200	5 6
Heifers in Calf	457,900	456,100	1,800	0·4	—	—
Other Cattle :						
Under one year	1,352,200	1,265,400	86,800	6·9	--	—
One year and under two	1,278,400	1,274,400	4,000	0·3		--
Two years and above	978,300	1,011,500	—	—	33,200	3 3
TOTAL OF CATTLE	6,658,200	6,619,200	39,000	0 6	--	—
Ewes kept for Breeding*	8,340,300	7,320,500	1,019,800	13 9	-	—
Other Sheep .						
One year and above	1,511,600	1,486,700	24,900	1 7	—	—
Under one year	7,716,200	8,387,000	—	—	670,800	8 0
TOTAL OF SHEEP	17,568,100	17,194,200	373,900	2·2	—	—
Sows kept for Breeding	431,700	455,400	—	—	23,700	5·2
Other Pigs :						
Over two months	2,235,800	2,140,500	95,300	4 5	—	—
Under two months	881,200	1,039,100	—	—	157,900	15·2
TOTAL OF PIGS	3,348,700	3,635,000	. .	—	86,300	2 4
Horses used for Agricultural purposes (including Mares for Breeding)	558,100	554,800	3,300	0 6	—	—
Unbroken Horses (including Stallions) .						
One year and above	106,200	101,000	5,200	5·1	-	—
Under one year	52,300	53,700	—	—	1,400	2·6
Other Horses	133,100	149,200	-	—	16,100	10 8
TOTAL OF HORSES	849,700	858,700	—	—	9,000	1 0
	No Thousands	*No Thousands*	*No Thous*	*Per Cent*	*No Thous*	*Per cent*
Fowls .						
Over 6 months old	22,782	24,377	—	—	1,595	6·5
Under 6 months old	29,412	28,256	1,156	4·1	—	—
TOTAL	52,194	52,633	—	—	439	0·8
Ducks	2,323	2,285	38	1·7	—	--
Geese	595	553	42	7·6	—	-
Turkeys	785	680	105	15·4	--	—

* Includes 1,479,700 two-tooth ewes in 1938 not separately distinguished in 1937, some of which were included last year among " other sheep "

Agricultural Workers

	1938	1937	Increase		Decrease	
	No	*No*	*No.*	*Per cent*	*No*	*Per cent.*
Regular Male Workers:						
21 years old and over .	379,500	395,200	--	—	15,700	4·0
Under 21 years old .	89,600	94,600	—	–	5,000	5·3
TOTAL	469,100	489,800	–	- -	20,700	4·2
Casual Male Workers —						
21 years old and over .	47,600	58,000	—	—	10,400	17·9
Under 21 years old .	6,200	7,300		—	1,100	15·1
TOTAL	53,800	65,300	-	–	11,500	17·6
TOTAL MALE WORKERS, REGULAR AND CASUAL .	522,900	555,100	-	-	32,200	5·8
Women and Girls						
Regular Workers	41,200	46,200	–	-	5,000	10·8
Casual Workers	25,400	30,400	--	-	5,000	16·4
TOTAL	66,600	76,600		-	10,000	13 1
TOTAL WORKERS, ALL CLASSES	589,500	631,700	-	—	42,200	6 7

All classes of agricultural workers showed a decline in numbers as compared with 1937, the total decrease amounting to 42,200 or 6·7 per cent The greatest reductions occurred in casual workers, males over 21 years old declining by 10,400 or 17·9 per cent, those under 21 years old by 1,100 or 15·1 per cent, and women and girls by 5,000 or 16·4 per cent The total decrease in regular male workers showed a fall of 20,700 or 4·2 per cent, while the numbers of regular women workers were reduced by 5,000 or 10 8 per cent

This year June 4 occurred on Whit. Saturday, when the yearly and half-yearly hirings customary in some parts of England and Wales normally terminate Many of the workers so engaged would have already left their employment on that day and would not have commenced the succeeding hiring. It is possible that some of the workers of this class may have been omitted from the returns.

MISCELLANEOUS NOTES

The Agricultural Index Number, July, 1938

The general index number of prices of agricultural produce for July at 122 (base July, 1911-13=100) is 2 points below that recorded for June and 9 points lower than in the corresponding month of 1937. If allowance be made for payments under the Wheat Act, 1932, and the Livestock Industry Act, 1937, the revised index is 127. Average prices of wheat, oats, bacon pigs, eggs, butter, cheese, hay and wool advanced during the month under review, while those of barley, fat cattle and sheep, pork pigs and poultry were reduced.

Monthly index numbers of prices of Agricultural Produce. (*Corresponding months of* 1911–13 -- 100)

Month	1933	1934	1935	1936	1937	1938
January ..	107	114	117	119	130	134
February	106	112	115	118	129	130
March	102	108	112	116	130	126
April	105	111	119	123	140	132
May	102	112	111	115	133	125
June .. .	100	110	111	116	131	124
July .. .	101	114	114	117	131	122
August .. .	105	119	113	119	133	—
September	107	119	120	127	137	—
October ..	107	114	113	125	131	—
November .	109	114	113	125	133	—
December .. .	110	113	114	126	132	—

Revised monthly index numbers of prices of Agricultural Produce, allowing for payments under the Wheat Act (*a*) *and for the Cattle subsidy* (*b*).

Month	1933	1934	1935	1936	1937	1938
January	111	119	124	125	133	138
February . ..	110	117	122	123	133	135
March . .	106	112	118	122	134	131
April ..	109	116	126	128	143	137
May	105	116	117	120	136	130
June ..	104	114	117	121	134	129
July	104	117	120	121	134	127
August	108	122	120	124	136	—
September	111	125	128	133	142	—
October .	112	121	119	129	134	—
November .. .	113	120	119	129	137	—
December	114	120	120	130	136	—

(*a*) Commenced August, 1932 (*b*) Commenced September, 1934.

In the following table the monthly index numbers of prices of individual commodities are shown for the months of April, to July, 1938, July, 1937, and July, 1936; base, the corresponding months of 1911-13 = 100.

Commodity	1938				1937	1936
	July	June	May	April	July	July
Wheat	99	100	100	100	120	86
Barley	120	138	137	146	127	84
Oats	113	113	111	113	121	83
Fat cattle	111	110	111	115	114	100
„ sheep	97	100	110	119	145	128
Bacon pigs	121	121	124	130	117	113
Pork „	120	123	126	132	115	106
Eggs	150	133	133	129	144	123
Poultry	127	130	127	118	130	117
Milk	175	175	175	215	175	175
Butter	121	124	121	111	112	100
Cheese	148	138	128	119	128	113
Potatoes	152	172	170	120	142	139
Hay	85	83	79	76	95	82
Wool	90	89	95	102	143	94
Dairy cows	115	118	116	117	115	104
Store cattle ..	112	113	112	119	120	101
„ sheep ..	95	—	90	105	139	113
„ pigs	145	140	140	145	133	126

Revised index numbers due to payments under the Wheat Act and to the Cattle subsidy.

Wheat	123	125	125	131	123	112
Fat cattle	125	123	125	129	128	114
General Index ..	127	129	130	137	134	122*

* Superseding figure previously published.

Grain. Wheat averaged 8*s.* per cwt., a rise of 1*d.* per cwt. on the month but, with a more pronounced upward movement in the base prices, the index is 1 point lower. If the deficiency payment under the Wheat Act, 1932, is taken into account the index is 123. The price of barley fell by 1*s.* 3*d.* to 9*s.* per cwt. and the index recedes by 18 points. Oats, at 8*s.* 8*d.* per cwt., averaged 2*d.* more than in June but the index remains at 113. In July, 1937, wheat averaged 9*s.* 8*d.*, barley 9*s.* 6*d.*, and oats 9*s.* 3*d.*, per cwt.

Live Stock. Prices of fat cattle were again reduced, second quality at an average of 39*s.* 4*d.* per live cwt. being 1*s.* 7*d.* less than a month ago but, a somewhat greater fall having

taken place during the base months, the index is 1 point higher. The addition of the subsidy under the Livestock Industry Act, 1937, brings the index to 125. Second quality fat sheep at 7*d.* per lb., averaged ¼*d.* less and the index declines by 3 points. Quotations for bacon pigs advanced by 3*d.* to 12*s.* per score of 20 lb.; the index, however, at 121 is repeated. Pork pigs, at 12*s.* 5*d.* per score, were reduced in price by 2*d.* and the index is 3 points lower.

Dairy cows and store cattle were both cheaper as compared with June, the relative indices falling by 3 points and 1 point. Store sheep averaged 28*s.* 11*d.* per head, the index standing at 95. Store pigs were unchanged in price but, with a downward movement in the base prices, the index is 5 points higher.

Dairy and Poultry Produce. The regional contract price of liquid milk and also the index were again unaltered on the month. Quotations for butter advanced by ¼*d.* to 1*s.* 2½*d.* per lb. but, owing to a greater increase having been recorded in the months of July, 1911-13, the current index falls by 3 points. Eggs continued to realize more money, second quality averaging 14*s.* 9*d.* per 120 as against 11*s.* 8*d.* a month earlier, and the index appreciates by 17 points. Cheese, at £4 19*s.* per cwt., averaged 3*s.* more than in June and the index shows a rise of 10 points. The combined index for poultry is reduced by 3 points.

Other Commodities. During the months of July and August, prices of certain varieties of first earlies are used in compiling the potato index. The average for July at £8 9*s.* per ton is 10*s.* 6*d.* higher than a year ago and the index is 152, as against 142 in July, 1937. Quotations for both clover and meadow hay again favoured sellers, the combined index for hay advancing by 2 points. At 11⅝*d.* per lb., wool was slightly dearer and the index is 1 point higher.

Sampling Observations on Wheat, 1937-38: Report for the Third Quarter

These observations cover the months from April to June and form part of a study of the growth of wheat at a number of stations throughout the country and over a number of seasons. Particular interest attaches to this quarter's observations on account of the exceptional drought which the country suffered. It would be difficult to imagine a more striking contrast in weather than that of the springs of the past two years.

Wheat has withstood the drought well. April, with continued dry weather and frequent night frosts, was evidently the most trying month. Checks in growth, yellowing of the leaves and mildew are reported, but with the breaking of the drought and the warmer weather in May steady progress was resumed. Indeed, ear emergence was reached some three days earlier than usual. Shoot densities and shoot heights at this stage vary considerably from station to station, but over all stations they differ little from normal. There are no signs of marked damage to the crops, either in the measurements or in the observers' comments, and yields at least up to the average may be anticipated in these experiments.

The Tables indicate the state of the crop at the periods of maximum shoot density, maximum growth rate and ear emergence. The stations are arranged in order of sowing date. Large differences are apparent from station to station in the observations covering maximum shoot density. The dates range from March 11 at Wye to May 5 at Sprowston, while the maximum densities themselves vary from 2,000 to 6,000. These figures, have, however, relatively little influence on the future progress of the crop. It will be seen that the influence of sowing date is still apparent at this stage. By ear emergence, however, the relative dates are determined mainly by the locality, the date becoming progressively later as we proceed from the southern stations (Newton Abbot, Wye and Plumpton) towards Boghall in Scotland. The total range at this stage is only 14 days, though it usually becomes more extended at harvest.

The crop was increasing in height most rapidly during the last week in May and the first week in June, slightly earlier than usual at most stations. The only marked exception was Yeoman at Plumpton, which continued to increase rapidly during ear emergence, so that the date of maximum growth could not be accurately determined. The maximum rates of increase were 2.0 cm. per day for Squarehead's Master and 1.7 cm. per day for Yeoman, these being slightly lower than in past seasons.

Varietal differences are as usual well marked at ear emergence. Squarehead's Master is on the average 10 cm. taller than Yeoman and emerges about a day earlier, while Yeoman is the denser crop.

TABLE I

Station	Variety	Maximum Shoot Density: Date, 1938	Maximum Shoot Density: Date, Average 1933–7	Maximum Shoot Density: Shoot Density per 32 m, 1938	Maximum Shoot Density: Shoot Density per 32 m, Average 1933–7	Shoot Height cms	Maximum Growth Rate: Date, 1938	Maximum Growth Rate: Date, Average 1933–7	Maximum Growth Rate: Rate cms per day, 1938	Maximum Growth Rate: Rate cms per day, Average 1933–7	Shoot Density per 32 m	Shoot Height cms
WYE, Kent	S H M*	Mar 13 09	April 18	5,462	3,564	3 02	May 28 56	June 6[1]	2 33	2 52[1]	2,133	56.73
	Yeoman	Mar. 11 30	April 22	6,216	3,937	2 57	May 27 44	June 8[1]	2 04	2 01[1]	2,480	46 57
PLUMPTON, Sussex	S H M	Mar 20 28	April 27[1]	2,826	2,525[1]	—	—	June 9[1]	1 62	2 45[1]	—	—
	Yeoman	Mar 24 42	April 23[1]	2,829	3,135[1]	—	June 8 81	June 12[1]	1 31	2 12[1]	2,055	45·94
CIRCENCESTER, Gloucestershire	S H M	April 10 81	April 29[1]	3,354	3,630[1]	2 72	May 31 82		1 72	—	1,835	35 87
	Yeoman	April 11 57	April 30[1]	4,377	4,844[1]	2 27	June 8 23	—	1 42	—	2,081	38 91
	Little Joss	April 13 84	—	3,678	—	2 61	June 2 37	—	1 69	—	2,029	33 47
NEWPORT, Shropshire	S H M	April 21 13	May 11[2]	2,181	2,330[2]		May 27 64	June 9[3]	2 13	2 75[3]	1,380	46 25
	Yeoman	April 24 38	May 22[2]	2,605	2,330[2]		May 28 93	June 9[3]	1 87	2 53[3]	1,577	38 43
BOGHALL, Edinburgh	S H M	April 30 86	May 1	3,481	4,033	—	—	June 15	—	2 34	—	—
	Yeoman	April 30 39	May 4	3,949	4,293	—	—	June 16	—	2 00	—	—
WOBURN, Bedfordshire	S H M	April 1 65	April 11	4,142	3,807	3 39	June 3 96	May 29[4]	1 74	–	2,582	38 91
	Yeoman	April 2 79	April 17	4,273	4,210	2 70	June 3 52	May 31[4]	1 40	–	2,728	33 45
NEWTON ABBOT, (Seale-Hayne College) Devonshire	S H M	April 7 66	Mar 28	5,370	4,220	7 52	May 22 88	—	2 57	—	2,484	59·96
	Yeoman	April 7 89	Mar 28	5,901	4,977	4 57	May 25 41	—	2 17	–	2,639	49·71
	Victor	April 7 20	—	5,440	—	6 07	May 24.56	—	2 56	—	2,500	59 44
ROTHAMSTED, Hertfordshire	S H M.	April 15 37	April 10	2,894	4,225	3 13	June 2 39	June 6	1 97	2 72	1,783	40 58
	Yeoman	April 29 38	April 12	3,390	5,230	3 91	June 4 46	June 8	1·67	1 90	2,166	34·78
	Victor	April 25 45	—	2,384	—	4 09	June 4 51	—	1 83	—	1,642	39·26
SPROWSTON, Norfolk	S H M	May 1 27	April 17	2,024	3,606	3 95	June 3 22	June 7	2 24	2 50	1,470	48·08
	Yeoman	May 5 28	April 21	2,106	4,312	3 76	June 3 31	June 9	2 06	2 05	1,581	41·28

* Squarehead's Master Omitting (1) 1933, (2) 1935, (3) 1937, (4) 1934 and 1935.

TABLE II.—EAR EMERGENCE

Station	Variety	Date 1938	Date Average 1933–7	Rate % per day 1938	Shoot Density per 32 m. 1938	Shoot Density per 32 m. Average 1933–7	Shoot Height (cm.) 1938	Shoot Height (cm.) Average 1933–7
WYE, Kent	S H M *	June 14 75	June 19	14 5	1,963	1,873	90 93	74·06
	Yeoman	June 14 80	June 20	14 0	2,188	1,991	76 94	63 58
PLUMPTON, Sussex	S H M	June 15 94	June 20[2]	18 4	1,655	1,326[3]	66 86	78 61[3]
	Yeoman	June 16 42	June 21[3]	21 2	1,881	1,485[3]	56 56	66 58[3]
CIRENCESTER, Gloucestershire	S H M	June 18 76	—	9 8	1,563	—	62 39	—
	Yeoman	June 19 33	—	12 3	1,700	—	55 82	—
	Little Joss	June 20 23	—	9 6	1,302	—	64 59	—
NEWPORT, Shropshire	S H M	June 18 95	June 23	14 6	1,201	1,466	81 68	91 14
	Yeoman	June 20 64	June 26	11 2	1,255	1,535	69 13[1]	78·10
BOGHALL, Edinburgh .	S H M	Before	July 2	—	1,456	1,793	69 79[2]	77 78
	Yeoman	June 28	July 3	—	1,486	2,051	59 89[2]	69·37
WOBURN, Bedfordshire	S H M	June 18 91	June 21[4]	8 0	2,295	1,857[5]	61 62	—
	Yeoman	June 19 59	June 22[4]	9 9	2,263	1,963[5]	52 91	—
NEWTON ABBOT, (Seale-Hayne College), Devonshire	S H M	June 13 67	June 15	11 2	2,062	1,778	99 36	—
	Yeoman	June 14 72	June 15[4]	13 6	2,223	2,040[4]	82 81	—
	Victor	June 14 55	—	13 9	1,996	—	98 57	—
ROTHAMSTED, Hertfordshire	S.H M	June 21 59	June 22	9 8	1,444	1,697	66 14	76·07
	Yeoman	June 22.75	June 23	12 6	1,745	1,941	57 13	63·87
	Victor	June 22.58	—	13 0	1,379	—	64 32	—
SPROWSTON, Norfolk .	S.H M.	June 20 11	June 21	12 9	1,333	1,642	79 06	71·93
	Yeoman	June 22 31	June 24	12 4	1,387	1,807	70 34	60·22

(1) On June 20 On Ju 8 Omitting (3) 1933. (4) 1936.

NOTE.—Certain values be dete ied for inclusions in Tables I and II because the observ the sta s concerned were incomplete.

Accommodation of Hop-pickers and Other Persons engaged temporarily in Picking, Gathering or Lifting Fruit, Flowers, Bulbs, Roots or Vegetables

Under Section 270 of the Public Health Act, 1936, which came into force on October 1, 1937, Local Authorities have power to make byelaws for securing the decent lodging and accommodation of hop-pickers and other persons engaged temporarily in picking, gathering or lifting fruit, flowers, bulbs, roots or vegetables. The then existing model byelaws issued by the Ministry of Health for the guidance of Local Authorities, a copy of which was reproduced in the issue of this JOURNAL for June, 1937,* applied only to persons engaged in hop-picking or in the picking of fruit and vegetables. Following consultation with the Ministry of Agriculture and Fisheries and with representatives of Local Authorities and agricultural interests, the Ministry of Health has now issued a new print of these byelaws which, apart from their application to the additional categories of workers referred to above, remain unaltered.

Committee on the Imposition of Penalties by Marketing Boards and Other Similar Bodies

The Treasury have appointed a Departmental Committee to enquire into the present arrangements for the imposition and recovery of penalties for contravention of schemes established under Statute for the organization of agriculture and other industries, to consider whether any modifications of these arrangements are desirable and practicable and to make recommendations.

The Chairman of the Committee is Viscount Falmouth and the members are:—

John Cameron, Esq., K.C., Colonel Sir Reginald Dorman-Smith, J.P., M.P., Sir Henry Fountain, K.C.M.G., C.B., George Lathan, Esq., J.P., M.P.; Richard O'Sullivan, Esq., K.C., Major Goronwy Owen, D.S.O., D.L., M.P.

The Secretary of the Committee is Mr. W. C. Tame and the Assistant Secretary Mr. H. E. James, both of the Ministry of Agriculture and Fisheries. All communications should be addressed to the Secretary of the Committee at 10, Whitehall Place, S.W.1.

* p. 267.

Health Certification of Plant Material for Export

Most countries require imported plants, potatoes, etc., to be accompanied by some form of health certificate involving an inspection of the consignment before export. Although differing in details, the various regulations laid down by the authorities in the countries that import plants from England and Wales usually necessitate a critical examination, by one of the Ministry's inspectors, of the material to be exported. This examination is normally carried out on the premises of the grower or exporter. The certificates, although varying in terms according to the requirements of the particular importing country concerned, are usually to the effect that the consignment was found to be healthy and free from injurious plant diseases and insect pests. This export trade is of appreciable value to the horticultural industry, and most growers throughout the country realize the importance of maintaining the high reputation for health and freedom from disease now generally associated with British plants; very few consignments presented for examination fail to reach the high standards essential for certification.

(*a*) NURSERY STOCK, ETC. The number of certificates (including *Phylloxera* certificates) issued in respect of consignments of nursery stock, etc., exported from England and Wales in each of the last four years, and the total estimated value of the consignments concerned are as follows:—

Year	*No. of Certificates*	*Value (£)*
1934	4,489	34,175
1935	4,674	40,007
1936	5,114	39,895
1937	6,244	46,844

Prominent categories included in these totals are Orchids (£17,200 in 1936: £21,272 in 1937); Bulbs (£6,600 in 1936: £7,617 in 1937) and Manetti stocks (£4,600 in 1936: £6,545 in 1937).

(*b*) POTATOES. Appreciable quantities of English potatoes are exported annually to Spain, Algeria, French Morocco and the Canary Islands. Normally the trade consists mainly of seed potatoes, but in some years short crops abroad, particularly in South American countries, may lead to a demand for supplies of ware.

Details are given in the following table of the quantity and

value of the potatoes certified for export during the past four years:—

Year	*Tons*	*Value* (£)
1934	24,834	118,622
1935	20,986	116,001
1936	18,552	111,563
1937	31,018	213,726

The quantities taken by the principal importing countries were:—

	1936 (*tons*)	1937 (*tons*)
Spain	10,150	14,188
Argentina	—	9,755
Algeria	3,930	1,707
French Morocco	1,500	1,175
Canary Islands	610	892

Amongst other importing countries may be mentioned Portugal, Egypt, Uruguay, Jamaica, France and the Channel Islands.

There has been a steady rise in the average value per ton of these exported potatoes from £4 15*s*. 0*d*. in 1934; £5 10*s*. 0*d*. in 1935; £6 0*s*. 0*d*. in 1936 to £6 18*s*. 0*d*. in 1937.

Agricultural Research Scholarships, Studentships for Research in Animal Health and Veterinary Scholarships

On the recommendation of the Agricultural Research Council, the following awards have been made by the Minister of Agriculture and Fisheries and the Department of Agriculture for Scotland:—

R. E. TAYLOR, B Sc, PH D, of King's College, Newcastle-upon-Tyne—a three-year Research Scholarship in Plant Pathology, the first year to be spent at Cambridge

I. F. STOREY, B.Sc., of Victoria University, Manchester, and the Imperial College of Science and Technology—a one-year Research Scholarship in Plant Pathology at the Imperial College.

D. C. THOMAS, B Sc, of the Imperial College of Science and Technology—a two-year Research Scholarship in Entomology, the first year to be spent at Cambridge

G. W. COOKE, B Sc, of University College, Nottingham—a three-year Research Scholarship in Soil Chemistry, the first year to be spent at the Rothamsted Experimental Station

M. R. F. ASHWORTH, B.Sc, of Oriel College, Oxford—a one-year Research Scholarship in Soil Chemistry at the Macaulay Institute for Soil Research.

D. J. FINNEY, B A, of Clare College, Cambridge—a two-year Research Scholarship in Agricultural Statistics, the first year to be spent at University College, London.

A. N. WORDEN, M.R.C.V.S., of the Royal Veterinary College, Camden Town—a three-year Studentship in Animal Health, the first period to be spent at the Lister Institute.

J. A. CAMPBELL, B A , of Downing College, Cambridge, a four-year Veterinary Scholarship at the Royal Veterinary College, Camden Town

J. L. McGIRR, B Sc., of Glasgow University—a four-year Veterinary Scholarship at the Royal Veterinary College, Camden Town

United Dairies Scholarship Fund: Successful Candidates, 1938-39

Name and School	*Award*
H. L HAWKINS, Bridport Grammar School	1-year Course in Dairying, tenable at Somerset Farm Institute, Cannington.
J.R PERRETT, Bath Technical School.	1-year Course in Dairying, tenable at Somerset Farm Institute, Cannington
Miss D. M. BRIMBLE, Colstons' Girls' School, Bristol.	2 terms course in Dairying, tenable at Somerset Farm Institute, Cannington
Miss E G SMALL, Bridgwater County School for Girls	Extension Course for the National Diploma in Dairying, tenable at the University, Reading
Miss R A WHITE, Dorchester Girls' County School	Extension Course for the National Diploma in Dairying, tenable at the University, Reading.

Post-Graduate Agricultural Scholarships

The scheme of Post-Graduate Agricultural Scholarships for students who propose to follow the career of Agricultural Organizer or Instructor or Lecturer in Agriculture is administered jointly by the Ministry and the Department for Scotland. The selection of candidates for this year's awards has now been completed, and scholarships, each of one year's duration, have been awarded to the following:—

Edward Dawson, University of Leeds; James K. Gaunt, University of Leeds; Matthew J Hamlyn, University of Reading, and Thomas H. Vickers, King's College, University of Durham.

The object of the scholarships is to broaden the agricultural knowledge and experience of students and so to qualify them for the type of career above-mentioned. The successful candidates will be attached for the period of the awards to County and other Agricultural Education Institutions and Advisory Centres to enable them to maintain a close contact with the practical side of teaching and advisory work and to familiarize them with county agricultural education work generally.

FOOT-AND-MOUTH DISEASE

The restrictions imposed on account of the outbreak of disease in the Isle of Wight, referred to in this JOURNAL for August, were withdrawn on August 16

An outbreak was confirmed on August 19 at Glanconway, Denbighshire, and infected area restrictions were imposed over an area of approximately fifteen miles radius of the infected place. The counties affected are Anglesey, Caernarvon, Denbigh and Flint.

FARM WORKERS' MINIMUM RATES OF WAGES

Agricultural Wages Board. A meeting was held at Kings Buildings, Smith Square, London, S W 1, on July 26, 1938 The Board considered notifications from Agricultural Wages Committees of decisions fixing minimum and overtime rates of wages, and proceeded to make the following Orders —

Cambridgeshire and Isle of Ely An Order fixing special minimum rates of wages for male and female workers employed on harvest work during the period of the Corn Harvest of 1938 The rate in the case of male workers of 21 years of age and over is a sum of £12 (as in 1937) to cover a period of four weeks of 64 hours per week (excluding Sunday) and in addition 11*d* per hour for any employment on Sundays, and in excess of 64 hours per week In the case of female workers of 18 years of age and over, the rate is 8*d* per hour (as in 1937) for all time spent on the corn harvest.

Essex An Order fixing special minimum hourly rates of wages for male and female workers employed on harvest work during the Corn Harvest of 1938 In the case of male workers of 21 years of age and over the minimum rate is 10½*d* per hour (as in 1937) and in the case of female workers of 21 years of age and over 7½*d* per hour (as in 1937) for all time worked on the harvest

Monmouthshire. An Order fixing minimum and overtime rates of wages to come into force on September 16, 1938 (i e , the day following that on which the existing rates are due to expire) and to continue in operation until March 15, 1939 The minimum rate in the case of male workers of 21 years of age and over is 35*s*. (instead of 34*s*) per week of 54 hours in summer and 50 hours in winter The overtime rates for adult male workers remain unchanged at 9½*d* per hour on weekdays and 11½*d* per hour on Sundays, Christmas Day and Boxing Day. The minimum rate in the case of female workers of 17 years of age and over is 6½*d* per hour (as formerly) for all time worked.

Suffolk An Order fixing special minimum rates of wages for male workers employed in agriculture during the Corn Harvest of 1938 The rate in the case of male workers of 21 years of age and over employed on harvest work throughout the harvest period on farms where the total acreage of corn is at least 60 acres is not less than the ordinary minimum rate otherwise applicable with, in addition, a bonus of £5 payable on completion of the harvest period; the hours of work in respect of which this rate is payable are 11½ on any weekday whilst harvest work is in progress. In the case of workers of 21 years of age and over who do not work on harvest work throughout the harvest period or who are employed on farms where the total acreage of corn is less than 60 acres the rate is 10*d* per hour for all employment on harvest work.

Miscellaneous Notes

Enforcement of Minimum Rates.—During the month ending August 12, 1938, legal proceedings were taken against three employers for failure to pay the minimum rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases follow —

Committee Area	Court	Fines Imposed	Costs Allowed	Arrears of Wages ordered	No. of workers involved
		£ s. d	£ s d	£ s. d	
Cheshire .	Nantwich	7 10 0	2 7 0	31 10 0	3 (*a*)
Lancs	Wigan	2 0 0	2 8 0	12 19 4	1
Suffolk .	Lowestoft	5 0 0	.	33 12 11	1
	Total .	£14 10 0	4 15 0	78 2 3	5

(*a*) Case of one worker withdrawn

APPOINTMENTS

COUNTY AGRICULTURAL EDUCATION STAFF: ENGLAND

Berkshire: Mr W. G Hume has been appointed Assistant Instructor in Horticulture.

Surrey: Mr. C P Quarrell, B Sc (Hort), has been appointed Horticultural Superintendent *vice* Mr. A. E Burgess, M.B E , F.R H S , and Mr. D V. Ingram, N D H , has been appointed Instructor in Horticulture *vice* Mr C H. Middleton, N D H , F R H S.

WALES

Monmouthshire Mr. Efan David, B Sc , Lecturer in Agriculture, and Miss M A Price, B Sc., Assistant Instructress in Rural Domestic Economy, have resigned.

Cardiganshire · The death is announced of Mr. H. Powel Evans F.B.S.A , County Poultry Instructor.

WIRELESS TALKS, SEPTEMBER 1938,

Station and Date	*Time p m*	*Speaker*	*Subject*
West:			
September 6	9 45	Devon *v.* Cornwall	Agricultural Bee.
September 15	9 40	Mr. A Hurd	For Western Farmers.
Midland:			
September 2	7 00	——	Kington Ewe Fair—a recorded impression by the B.B C. Mobile Unit.
September 22	—	Mr. W. A Stewart	Balanced Rations for Winter Feeding.

PRICES OF FEEDING STUFFS

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb	Price per unit starch equiv	Price per lb. starch equiv.	Protein equiv.
	£ s	£ s	£ s		s d	d.	%
Wheat, British..	8 7	0 9	7 18	72	2 2	1·16	9·6
Barley, Canadian No 3 Western	7 0	0 9	6 11	71	1 10	0·98	6·2
,, American	6 12§	0 9	6 3	71	1 9	0·94	6·2
,, Argentine .	6 17§	0 9	6 8	71	1 10	0·98	6·2
,, Australian	7 17§	0 9	7 8	71	2 1	1·12	6·2
,, Persian	6 8*	0 9	5 19	71	1 8	0·89	6·2
Oats, English, white .	9 7	0 9	8 18	60	3 0	1·61	7·6
,, ,, black and grey	9 3	0 9	8 14	60	2 11	1·56	7·6
,, Scotch, white	10 0	0 9	9 11	60	3 2	1·70	7 6
,, Canadian— No 2 Western	9 17*	0 9	9 8	60	3 2	1·70	7 6
No. 1 feed	8 7§	0 9	7 18	60	2 8	1·43	7·6
mixed feed	7 3	0 9	6 14	60	2 3	1·21	7·6
,, Argentine	8 13	0 9	8 4	60	2 9	1·47	7·6
Maize, American	6 15	0 7	6 8	78	1 8	0·89	7·6
,, Argentine .	7 12	0 7	7 5	78	1 10	0·98	7·6
,, Danubian Gal Fox	6 17	0 7	6 10	78	1 8	0 89	7 6
,, South African, No 2 White Flat	7 3†	0 7	6 16	78	1 9	0 94	7 6
Peas, Japanese	19 17†	0 15	19 2	69	5 6	2·95	18·1
Dari	8 0†	0 8	7 12	74	2 1	1·12	7·2
Milling Offals—							
Bran, British	7 0	0 17	6 3	43	2 10	1·52	9·9
,, Broad	7 2	0 17	6 5	43	2 11	1·56	10·0
Middlings, fine, imported	7 10	0 14	6 16	69	2 0	1·07	12·1
Weatings‡	7 15	0 15	7 0	56	2 6	1·34	10·7
,, Superfine‡	8 2	0 14	7 8	69	2 2	1 16	12·1
Pollards, imported	7 0	0 15	6 5	50	2 6	1·34	11·0
Meal, barley .. .	8 2	0 9	7 13	71	2 2	1·16	6 2
,, ,, grade II	7 7	0 9	6 18	71	1 11	1·03	6·2
,, maize .	7 10	0 7	7 3	78	1 10	0·98	7·6
,, ,, germ	7 10	0 11	6 19	84	1 8	0·89	10·3
,, locust bean	7 15	0 6	7 9	71	2 1	1·12	3·6
,, bean ..	9 7	0 18	8 9	66	2 7	1·38	19·7
,, fish (white)	15 0	2 6	12 14	59	4 4	2·32	53·0
,, Soya bean (extracted)‡	8 17	1 11	7 6	64	2 3	1·21	38·3
Maize, cooked, flaked ..	8 0	0 7	7 13	84	1 10	0·98	9·2
,, gluten feed ..	7 12	0 14	6 18	76	1 10	0·98	19·2
Linseed cake—							
English, 12% oil .	9 17	1 1	8 16	74	2 5	1·29	24·6
,, 9% ,, .	9 5	1 1	8 4	74	2 3	1·21	24·6
,, 8% ,,	9 0	1 1	7 19	74	2 2	1·16	24·6

PRICES OF FEEDING STUFFS *(continued)*

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s	£ s.		s d	d.	%
Cottonseed cake, English, Egyptian seed, 4½% oil ..	5 15	0 19	4 16	42	2 3	1 21	17·3
Cottonseed cake, Egyptian, 4½% oil ..	5 7	0 19	4 8	42	2 1	1·12	17·3
Cottonseed cake, decorticated, 7–8% oil	7 12†	1 10	6 2	68	1 10	0·98	34·7
Cottonseed meal, decorticated, 7–8% oil	7 15†	1 10	6 5	70	1 9	0·94	36·8
Coconut cake, 5% oil	7 15†	0 19	6 16	77	1 9	0·94	16·4
Ground nut cake, decorticated, 6–7% oil	8 12*	1 10	7 2	73	1 11	1 03	41·3
Ground nut cake, imported decorticated, 6–7% oil .	7 7	1 10	5 17	73	1 7	0·85	41 3
Palm-kernel cake, 4½–5½% oil	7 10†	0 13	6 17	73	1 11	1·03	16·9
Palm-kernel cake meal, 5½% oil	7 12†	0 13	6 19	73	1 11	1·03	16·9
Palm-kernel meal, 1–2% oil	7 2	0 13	6 9	71	1 10	0·98	16·5
Feeding treacle	5 0	0 8	4 12	51	1 10	0·98	2·7
Brewers' grains, dried ale	6 2	0 12	5 10	48	2 3	1·21	12·5
Brewers' grains, dried porter .	5 15	0 12	5 3	48	2 2	1 16	12·5

* At Bristol § At Hull † At Liverpool

‡ In these instances manurial value, starch equivalent and protein equivalent are provisional

NOTE : The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store The prices were current at the beginning of August, 1938, and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative values of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, if linseed cake is offered locally at £11 per ton, then since its manurial value is £1 1*s*, per ton as shown above, the cost of food value per ton is £9 19*s*. Dividing this figure by 74, the starch equivalent of linseed cake as given in the table, the cost per unit of starch equivalent is 2*s*. 8*d* Dividing this again by 22·4, the number of pounds of starch equivalent in one unit, the cost per lb. of starch equivalent is 1·43*d*. Similar calculations will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own markets. The figures given in the table under the heading " Manurial value per ton " are calculated on the basis of the following unit prices · N , 7*s* 9*d*., P_2O_5, 2*s*. 6*d*.; K_2O, 3*s* 6*d*

FARM VALUES OF FEEDING STUFFS

The prices in respect of the feeding stuffs used as bases of comparison for the purpose of this month's calculations are as follow :—

	Starch equivalent Per cent	*Protein equivalent Per cent.*	*Per ton £ s.*
Barley (imported)	71	6·2	6 19
Maize..	78	7·6	7 12
Decorticated ground-nut cake ..	73	41·3	7 19
" cotton-seed cake ..	68	34·7	7 12

(Add 10s. per ton, in each instance, for carriage.)

The Table below is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices (The "food values" which it is recommended should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows, are given in the November, 1936, issue of the Ministry's Journal, p. 816)

FARM VALUES

Crop	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent	Per cent	£ s.
Wheat ..	72	9·6	7 12
Oats..	60	7·6	6 6
Barley	71	6 2	7 8
Potatoes	18	0·8	2 17
Swedes	7	0·7	0 15
Mangolds	7	0·4	0 14
Beans .	66	19 7	7 5
Good meadow hay	37	4·6	3 18
Good oat straw	20	0·9	2 1
Good clover hay	38	7·0	4 1
Vetch and oat silage .	13	1·6	1 7
Barley straw .	23	0·7	2 7
Wheat straw	13	0·1	1 6
Bean straw . .	23	1·7	2 8

PRICES OF ARTIFICIAL MANURES

Description	Average prices per ton (2,240 lb) during week ended Aug 17				
	Bristol	Hull	L'pool	London	Costs per Unit ¶
	£ s	£ s	£ s	£ s	s d
Nitrate of Soda (N 15½%) .. *	8 0*c*	8 0*c*	8 0*c*	8 0*c*	10 4
,, ,, Granulated (N 16%) *	8 0*c*	8 0*c*	8 0*c*	8 0*c*	10 0
Nitrate of Lime (N 13%) .. *	7 7*e*	7 7*e*	7 7*e*	7 7*e*	11 4
Nitro-Chalk (N 15½%). *	7 10*c*	7 10*c*	7 10*c*	7 10*c*	9 9
Sulphate of Ammonia Neutral (N 20 6%) . *	7 3*c*	7 3*c*	7 3*c*	7 3*c*	7 0
Calcium Cyanamide (N 20 6%) *	7 9*d*	7 9*d*	7 9*d*	7 9*d*	7 3
Kainite (Pot 14%) §	2 18	2 15	2 15	2 15	3 11
Potash Salts (Pot 30%) . §	5 0	5 1	5 0	4 17	3 3
,, ,, (Pot 20%) . §	3 15	3 12	3 12	3 12	3 7
Muriate of Potash (Pot 50%) §	8 3	8 8	8 5	8 1	3 3
Sulphate ,, ,, (Pot 48%) §	9 13	10 0	9 17	9 11	4 0
Basic Slag (P A 15¾%) . §	2 12*b*	2 5*b*		2 10*b*	3 2
,, ,, (P A 14%) . §	2 8*b*	2 0*b*	2 0*b*	2 6*b*	3 3
Grd Rock Phosphate (P A 26-27½%) §	3 4*a*	3 0*a*	2 15*a*	2 10*a*	1 10
Superphosphate (S P A 16%) §	3 4		3 5*f*	3 2*g*	3 11
,, (S P A 13¾%) §	3 1	2 17	3 2*f*	2 19*g*	4 3
Bone Meal (N 3¾%, P A 20½%) §		7 5	7 0*h*	6 17	
Steamed Bone Flour (N ¾%, P A 27½–29¾%) . .. §	5 5*i*	4 15	4 7*h*	4 10	.

Abbreviations N = Nitrogen , P A = Phosphoric Acid , S P A = Soluble Phosphoric Acid , Pot = Potash

* Prices are for not less than 6-ton lots, at purchaser's nearest railway station, unless otherwise stated Unit values are calculated on carriage-paid prices

§ Prices are for not less than 2-ton lots, nett cash for prompt delivery f o r in town named, unless otherwise stated Unit values are calculated on f o r prices

a Prices for 4-ton lots f o r Fineness 85% through standard sieve

b Prices for 6-ton lots Prices at Bristol are f o r Bridgwater , at Hull and Liverpool f o r neighbouring works and at London f o r at depots in London districts Fineness 80% through standard sieve

c For lots of 4 tons and under 6 tons the price is 1*s* per ton extra, for lots of 2 tons and under 4 tons, 5*s* per ton extra, for lots of 1 ton and under 2 tons, 10*s* extra, and for lots of 2 cwt and under 1 ton, 20*s* extra

d Delivered in 5-ton lots at purchaser's nearest railway station For lots of 2 tons and under 5 tons the price is 5*s* per ton extra, for lots of 1 ton and under 2 tons, 10*s* per ton extra, and for lots of 4 cwt and under 1 ton, 20*s* extra

e For lots of 4 tons and under 6 tons the price is 1*s* per ton extra, for lots of 2 tons and under 4 tons, 5*s* per ton extra, for lots of 1 ton and under 2 tons 7*s* 6*d* per ton extra, and for lots of under 1 ton, 20*s* extra

f Prices shown are f o r Widnes

g Prices shown are ex works London , f o r southern rails, 1*s* 3*d* extra

h Prices shown are f o r Appley Bridge

i Price shown is f o r Newport, Mon

¶ *These are calculated by regarding a ton as comprising* 100 "*units*" (*equal parts of* 22 4 *lb*) *so that a fertilizer, for example, with* 16 *per cent nitrogen contains* 16 *such* "*units*" *in a ton Then, if the price per ton of such a fertilizer be divided by the percentage figure, the deduced cost is that of a* "*unit*" *of that agent Those in the table above are based on London prices* (*For further explanation, see Advisory Leaflet, No* 146, "*The Valuation of Artificial Manures,*" *obtainable from the Ministry, free of charge*)

NOTICES OF BOOKS

Introduction to Plant Pathology. By Frederick De Forest Heald, M.S., Ph.D. Pp. xi + 579 and 200 Figs. (London: McGraw-Hill Publishing Co., Ltd. 1937. Price 24s.)

This book is essentially Heald's well-known Manual of Plant Diseases condensed, changed in the order of presentation, and with the addition of several new chapters. In its new form it provides a more general and more balanced introduction to plant pathology.

The chapters added at the beginning deal with useful and harmful relations of fungi and bacteria to human affairs (in many instances not plant pathological), the nature and extent of losses caused by plant diseases; and the dissemination of plant diseases. Then follow the sections dealing in detail with fungus and bacterial diseases, virus diseases and non-parasitic diseases. Somewhat fewer types are dealt with than were treated in the earlier work, and much of the text has been condensed, often with advantage Most of the 200 illustrations used are the same as those which have already appeared in the Manual Finally, two new sections (about 80 pages) have been added, dealing in a rather systematized and abbreviated manner with plant disease prevention and control (4 chapters), and with methods of study (3 chapters)

The main fault about the book is that the bibliographical titles given at the ends of the chapters are new ones only, reference being given to the appropriate pages of the Manual of Plant Diseases (2nd edition) for previous literature. This means that for proper study both books must be available, and besides being largely duplicates of one another, they are expensive. It would have been much more useful to students if well-chosen lists of the most important references only had been used in the new book.

Apart from this serious fault the book provides an excellent introductory course for students of plant pathology. Sufficient detail is also given to make the book valuable as a reference work in connection with many of the commoner diseases. The book naturally deals more particularly with American conditions, but many of the diseases described are common in Europe

Dairy Produce. A summary of figures of production and trade relating to butter, preserved milk, cheese, casein, eggs and egg products. Obtainable from H.M. Stationery Office, York House, Kingsway, London, W.C.2. Price 2s. 6s. post free 2s. 8*d*.

This is the Imperial Economic Committee's annual summary of world production of and trade in the principal kinds of dairy and poultry produce, and deals with the years 1930—1936. Sections are devoted to production and exports, trade of the Empire as a unit, imports into the principal countries and into the United Kingdom particularly, of each product. Two appendices to the review contain detailed information as to the import duties and regulations affecting dairy produce imported into the United Kingdom and other important countries

The report shows that, following an increase in the proportion of dairy cows to total cattle and increased productivity per cow, there has been, on the whole, a continued increase in the world production of milk and dairy products.

The expansion in production of milk was accompanied up to 1936 by an increase in the trade in butter, but world exports of other milk products have tended to decline during the period under review.

World production of cheese in the past few years has increased, but to a less marked extent than that of butter. Exports of cheese from the chief exporting countries progressively declined by 21 per cent. between

1930 and 1936, the decline being most marked in those from the Netherlands. Imports into the United Kingdom decreased during the same period, and as home production showed little change, consumption per head diminished from 9.8 lb. in 1930 to 8.8 lb. in 1936.

Production of preserved milk in the United States, the world's largest producer, has shown a steady increase in recent years, but production in the other principal foreign exporting countries has declined. Imports of preserved milk into the United Kingdom since 1930 have declined, but they are still greater than those taken by any other importing country.

Egg production generally has tended to increase since 1930, but there is evidence that a peak in numbers of poultry has been reached in a number of countries.

The report gives a review of the movement in prices over the period 1930—1936, and it should prove of considerable interest and assistance to all engaged in the dairy and poultry industries and trade.

The Welsh Journal of Agriculture. Vol. XIII. Pp 347. (Cardiff: University of Wales Press. 1937. Price 2*s*. 6*d*.; cloth 4*s*.)

Farmers and others who desire reliable and up-to-date information regarding the results of agricultural investigations that have been conducted in Wales, and the principles of which apply elsewhere, cannot afford to neglect this journal, which is published under the auspices of the Welsh Agricultural Education Conference The present issue contains some thirty articles by specialists, who cover various aspects of agricultural research and practice as carried on in the Principality. These are followed by abstracts, reviews, bibliographical notes and a selection of the more important works on agriculture that have appeared during the past year.

The Agricultural Register, 1936-7. Pp viii+325 (Oxford: Agricultural Economics Research Institute. 1937. Price 5*s*)

The fourth issue of this valuable compendium follows the now familiar arrangement of its predecessors. It is by now hardly necessary to describe its contents in detail to readers of this Journal It contains a review of the legislative and other developments affecting agriculture during the year, together with a comprehensive collection of agricultural statistics both from official sources and from figures published by the various Marketing Boards The only change of consequence since the previous issue appears to be the rearrangement of the section on "Supplies and Prices," as a result of which the text has been somewhat shortened, but without any diminution in the amount of information supplied Like its predecessors, the present issue contains more information than can be found elsewhere between two covers, and is an indispensable work of reference.

The Farming Year. By J. A. Scott Watson. Pp 128. Illus. (London: Longmans. 1937. Price 7*s*. 6*d*.)

Readers of Professor Scott Watson's "Rural Britain To-day and To-morrow" will welcome this new volume. It is, in effect, a companion to that volume It describes in simple language the various systems of farming into which our agriculture can be divided and it places them in the different districts where they are practised. Produced as a result of the initiative of the National Federation of Young Farmers' Clubs, it should find a large public amongst farmers, both young and old, because any farmer in any part of the country will find in it much to interest and instruct. He will be able to learn how other men in other types of country-

side have planned their work to meet their particular conditions, and the townsman will find a readable and readily understandable outline of farming that describes, with the familiarity of one who is intimately acquainted with his subject, the wide divergences of practice and the complicated problems that go to make up the farmer's daily life.

The book also provides an historical background showing how the early labours of men went to make modern farming possible and how indeed, in many parts of the country, our forefathers no less than made the land. Forests had to be cleared, marshes to be drained, soils practically changed by mixing, a work of centuries that never really ceased in spite of temporary delays, often due to some economic crisis, or war-time demand

There have been many surveys of farming published in the past few years, most of which have a great deal to commend them Professor Scott Watson's work deserves to be ranked amongst the foremost of these, although it makes no pretence of being a detailed survey of the country. It, nevertheless, gives, by the apt selection of examples, a picture that is reasonably complete

The book is beautifully illustrated by a large number of fine photographs selected by Mr A Voysey of the Agricultural Staff of the Kent Education Committee

The Handbook of British Birds. 1st Volume. By Witherby, Jourdain, Ticehurst and Tucker Pp. xi + 326 and 32 plates. (London. H. F. & G Witherby, Ltd Price 21*s*. net)

The first volume of the long awaited new Handbook of British Birds will be welcomed by all ornithologists The term "Handbook," however, applied to so comprehensive and exhaustive a work, may be rather misleading

The present volume (Crows to Flycatchers, inclusive) gives a wealth of information on the habits and characteristics of the birds dealt with. The field notes are especially good, and will be of great value to the serious student of British bird life, novice or expert The names of the authors are sufficient guarantee of the reliability of the recorded observations, and the work as a whole may be regarded as a practically complete survey of present-day British ornithological knowledge

There have been objections to the trinomial system of nomenclature initiated by the British Ornithologists' Union and adopted in this work Whatever may be said for or against the system as opposed to the old binomial method, it is clear that the former has come to stay, and that no useful purpose will be served by further argument In any case, the question of nomenclature cannot affect the general, all-round merit of this work

If there is a fault, it is that the illustrations are rather small They are, however, very clear and accurate, and are the work of some of the foremost ornithological artists of the day It is said that the drawings are reproduced in a size most convenient for the work, and, in view of their number and of the fact that they show (in colour) not only plumage differences as between the sexes, but juvenile plumages also, it is difficult to dispute this assertion. In no other British ornithological work has illustration of such a scope been attempted

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NOTES FOR THE MONTH

Cereals for Autumn Sowing

At this time of year farmers are seriously considering which among the many available cereal varieties are likely to give the best financial return. The solution varies with soil, climate, and many other factors. The National Institute of Agricultural Botany has conducted systematic field trials for the last seventeen years with the more promising varieties, and is able to give reliable advice to farmers in the north Midlands, Midlands, South and East of England on the choice of varieties of wheat, barley and oats. There is a wide choice of good winter wheats, among the best being Juliana, Victor, Wilhelmina, the Yeomans, Holdfast, Little Joss, and Squarehead's Master or Standard Red. Other heavy yielding, but later ripening varieties, are Chevalier, Crown, Iron III, Steel, Weibull's Standard and Rivet; any of these, and especially Rivet, should be sown early. Desprez 80 (Joncquois), a very early-ripening and short-strawed variety, gives heavy yields on good soils. Were baking quality to assume greater importance than heretofore, Holdfast would, in such circumstances, be worthy of special attention, for baking tests have shown it to be of superior quality to the Yeomans, or in fact any other English wheat.

As regards barley, where winter hardiness is of first importance, the ordinary six-row winter is most satisfactory. Under favourable conditions Plumage-Archer or Spratt-Archer both withstand normal winters and give good malting samples as well as high yields. Among winter oats Grey Winter and Black Winter are the most hardy. On richer soils Bountiful stands better but is not so hardy. Where extreme winter hardiness is not required, and for very fertile soils, Resistance can be

recommended on account of its resistance to lodging, good quality straw and very high yields. The new Aberystwyth White Winter Oat S.147, now being marketed by the Institute for the first time this autumn, can be recommended for fertile soils where Grey Winter is likely to lodge. The use of the term " White Winter " as a varietal name for oats should be avoided, as it is ambiguous.

Brief particulars of the purposes for which the above varieties are adapted are given in Farmers' Leaflet No. 1 issued by the National Institute of Agricultural Botany. Copies can be obtained free of charge from the Institute at Cambridge or from any County Agricultural Organizer, and enquiries about these or other varieties are always welcome.

The Nutritive Value of Milk

A report* recently issued by the Milk Nutrition Committee deals with experiments carried out at the National Institute for Research in Dairying (University of Reading), and at the Rowett Research Institute, Aberdeen, to investigate the effect of commercial pasteurization on the nutritive value of milk by means of experiments on calves. The Milk Nutrition Committee had already issued two reports dealing, respectively, with the effect of commercial pasteurization on the nutritive value of milk as determined by experiments on rats and by chemical analysis, and with the effects of dietary supplements of pasteurized and raw milk on the growth and health of school children. Notes summarizing the contents of these reports have appeared in this JOURNAL for June, 1937 (p. 201), and May, 1938 (p. 111).

The latest report describes the results of three further sets of experiments, two of which were carried out at Aberdeen and one at Reading. In each set two similar groups of calves were fed, from a few days after birth, one on commercial raw milk and the other on an equal quantity of commercially pasteurized milk drawn from the same bulk as the raw milk. Milk only was given in the early stages of growth, but as it was desired to maintain the calves with as good a rate of growth as possible, solid supplements were fed to the two

* *Milk and Nutrition, New experiments reported to the Milk Nutrition Committee Part III* The Effect of Commercial Pasteurization on the Nutritive Value of Milk as Determined by Experiments on Calves pp. 27 + 4 inset tables. (To be purchased directly from the National Institute for Research in Dairying, Shinfield, Reading 1938. Price 2s. post free)

groups in equal quantities after the first few weeks. Care was taken to ensure that nothing was done which would assist or handicap one group more than another, the sole difference being that one group received pasteurized, and the other raw milk. Each set of experiments lasted about six months.

The experiments were not, of course, intended to serve in any way as a practical guide to calf rearing; calves were chosen merely as convenient animals for experiments undertaken to throw further light on the comparative nutritive value of commercial raw and pasteurized milk.

Whilst similar in most respects, the three experiments showed minor differences in the methods used and also minor differences in the results obtained. The report states that all three were "good" experiments in the sense that they were carefully planned and executed, and no reason is known why the results of each experiment should not be given full weight.

In the experiment at Reading no difference even approaching statistical significance was found in live weight, in appearance, or in blood composition, as between animals fed on raw and those fed on pasteurized milk. The growth curves of the two groups of calves were almost exactly superposable. There was a slight, but still insignificant, difference in favour of raw milk in certain body measurements.

The combined results of the two experiments conducted at Aberdeen indicated a slight, statistically significant advantage to the calves on raw milk in growth rate, but not in body measurements, general health, or blood composition. When each of these two experiments is considered singly, however, neither shows a statistical difference for any of the variables measured. When the two Aberdeen and the Reading experiments are combined statistically, which the report suggests is just as reasonable as taking two of them, there is no statistical difference shown between the effect of raw and of pasteurized milk on growth. The conclusion reached, therefore, is that any deleterious effects of pasteurization, as detectable by calf-feeding experiments of this type, is of a minor kind.

The tuberculin test was applied to all calves which completed the experiment, at about six months of age. Taking the results of the three experiments together, 17 out of 37 calves in the raw milk group (46 per cent.) and 5 out of 38 in the pasteurized milk group (13 per cent.) gave a positive tuberculin test.

The report also contains a valuable review, and summary in tabular form, of the several reports which have been issued since 1926 on the comparative nutritive values of raw and pasteurized milk as determined by calf-feeding experiments conducted in Great Britain, and compares the findings of the present report with previous work.

The bearing that the results recorded in this report may have on human nutrition are to be discussed in a later report, which is to be published when the final findings of the investigations carried out on school children have been collated.

ARE CULTIVATIONS OVERDONE?

B. A. KEEN, D.Sc., F.R.S.,

Assistant Director, Rothamsted Experimental Station

In most countries, and especially in Great Britain, farmers have a traditional belief in the necessity and the virtues of thorough soil cultivation. The *necessity* of some minimum amount of cultivation is self-evident but, in our climatic conditions of well distributed annual rainfall, it is commonly believed that cultivations additional to this minimum are essential, especially on medium and heavy soils, to secure a satisfactory tilth. The *virtues* of thorough cultivations cannot be so precisely defined, but it appears that most farmers believe the quality and yields of crops are improved by additional and deeper stirrings of the soil.

Whatever the reasons, the fact remains: even in the present difficult times, the great majority of farmers strive to keep up a high standard of cultivations, which still rank as probably the heaviest single item in the arable farmer's budget, and are certainly more expensive than his annual payment for fertilizers. Nevertheless, large numbers of manurial experiments have been and are being made, and the cumulative results are constantly being used to improve farming practice. But nothing of the kind was ever done for cultivations, probably because it was felt that the results would merely confirm the obvious.

In this connexion it is important to realize that our present accepted standards of cultivation grew up when there was an ample supply of low-wage labour and tractors were unknown. Putting men and horse teams on to a cultivation cost very little more than letting them stand idle, because wages had to be paid and horses fed in either event. In tricky seasons it was often impossible to finish the work before rain or drought came, with the common result that extra cultivations were afterwards necessary to bring the soil to the accepted standards of good tilth. From such considerations as these the traditional attitude to soil cultivation arose naturally and inevitably. The vital question is whether the tradition embodies a fundamental truth to be neglected at our peril, or whether, in the

changed economic conditions our standard of cultivations can be lowered without detriment. It may be said that the present wage level in relation to prices received for farm produce is forcing the farmer to lower his level of cultivations; it may further be argued that the tractor, by its superior speed and power, has reduced the number of cultivations required in tricky seasons; and attention may be directed to the fact that the tractor differs from the horse in needing fuel only when it is working, and thus (if properly cared for) costs nothing when it is idle. These arguments, although admittedly important, especially in their application to mechanized grain farms, deal primarily with problems of the best form of motive power for cultivations and questions of labour organization. They are not directed towards the fundamental questions: what is the real purpose of cultivation; and are our standards wastefully high?

The real purpose of cultivation can be easily defined: it is to secure a suitable seedbed for the particular crop and to maintain the soil in the best condition for plant growth throughout the life of the crop. Most text-books of practical agriculture give extended explanations of how the various cultivation operations achieve this end. Some are designed to allow the weather to act to the best advantage: autumn ploughing is an obvious example. Others are said to control the moisture conditions: thus, harrowing is believed to break the capillary films of moisture in the pore-spaces of the soil, so preventing further rise of water to the surface and thus reducing evaporation losses; rolling is believed to draw up moisture to the young plant from below, because of the superior capillary pull of the smaller pore-spaces in the compressed top layer of soil. These explanations, however, can no longer be accepted. They are based on the capillary theory of soil water movement which, although simple and plausible, is now disproved. Water does not, in fact, move from one place to another in the soil in the manner predicted by the capillary theory. It is relatively static and is either absorbed by plant roots that go in search of it or else it evaporates *in situ,* passing as water vapour into the larger pore-spaces and thence into the air. If the state of affairs pictured by the capillary theory were correct, the amount of water present would have to be such that rolling would have a disastrous effect on the tilth.

The text-book discussions of the effect of weather on tilth production are on sounder lines. The effect was well brought

out by some results obtained at Rothamsted on autumn-ploughed land at the time of spring cultivations. In one instance the winter of 1927-28 had been mild and wet; in the other instance the winter of 1925-26 had included dry spells and periods of frost. The condition of the soil immediately before the spring cultivations was measured by taking a block of it with minimum disturbance and placing it on a nest of wire sieves with square apertures ranging from 1½-in. side in the top sieve to 1/10-in. side in the bottom one. The nest was gently shaken until disintegration of the block had ceased. The proportion of lumps of different sizes into which the block had disintegrated was ascertained by weighing the contents remaining on each sieve. As would be expected, the soil after the hard winter broke up very easily into small and medium sized pieces and only a few lumps were left on the top sieve. The furrows were well weathered, and ready to fall down into an excellent seedbed, and called for no cultivation treatment beyond a single harrowing to level the surface. The behaviour of the soil after the mild and open winter was in striking contrast. Nearly two-thirds of the block remained on the top sieve in the form of large unkindly lumps.

Similar sieving measurements were made in each case immediately after the spring cultivations, and by comparing these results with those just discussed a measure of the disintegration produced by the implements was obtained. The implements employed were a ridging or bouting plough and a rotary cultivator (the Rototiller). On the weathered soil these implements produced little effect: there was a slight increase of the smaller-sized crumbs at the expense of the medium-sized ones, and the small number of large lumps was further decreased. But on the unweathered soil it was necessary to employ the drastic combination of rotary cultivator plus ridging plough before the soil could be disintegrated even to the extent displayed by the weathered soil *before* its spring cultivation. Nor was this all; for, although the sieving results showed the mechanical disintegration was about the same in these two comparisons, their state of tilth differed greatly. The unweathered soil showed what the farmer aptly calls a "forced" tilth, in marked contrast with the friable porous crumbs of the weathered soil.

As it appears that a primary purpose of cultivation is to allow the weather to act on the soil to the best advantage, and as the assertions, based on the capillary theory, that moisture

movements can be delicately controlled by appropriate cultivations no longer apply, it is natural to enquire whether crop yields are, in fact, affected by the number and type of cultivations given to the soil. As already stated, no serious investigation of this important matter was ever made in this country. About twenty years ago many experiments were made in the United States with special reference to the Great Plains region of limited rainfall. The results showed that deep cultivation was no better than shallow; that mulching did not conserve moisture; that the main object of cultivation, apart from loosening the soil for a seedbed, was to cope with the competition of weeds for the available food and water; and that the direct effect of cultivations on crop yields was negligible. This work received little attention in Great Britain owing, probably, to the feeling that results in dry-farming conditions could not apply in this country. Some twelve years ago experiments were begun at Rothamsted to measure the effect of cultivation on crop yields, with the full expectation that the more thorough the cultivations the better would be the yields. During this period the experiments have consistently contradicted our initial belief and we have been driven to conclusions that tally closely with those reached in the United States. Recently, experiments have been made at Cambridge that give results similar to ours.

The full details of the Rothamsted experiments will be found in the Annual Rothamsted Reports. A full discussion appears in the *Journal of Agricultural Science* for 1938 and a summarized account is given in Volume 98 of the *Journal of the Royal Agricultural Society of England.* Hence in the present article all details are omitted.

Subsoiling. On the Rothamsted soil a compressed layer or plough-sole tends to form and it is generally believed that subsoiling or deep ploughing is desirable in such conditions, especially for crops like sugar-beet. In 1928 the land was subsoiled to 14 in. behind the plough for a crop of sugar-beet. The mean yield of beet in this experiment was 9.15 tons p.a., and the increase due to subsoiling was less than 1 cwt., so the cost of the operation was wasted. In 1931 a more drastic trial was made and the subsoil was thoroughly broken up by hand forking, but the labour of double-trenching, far from producing an increase, gave a decrease of nearly 5 cwt. p.a. on a mean yield of 12.66 tons p.a.

Extra Ploughings. In 1934 two experiments were made, one on potatoes and the other on sugar-beet, to see the effect of withholding either the autumn or the spring ploughing, both of which constitute the normal preparation for root crops. In the potato experiment one set of plots received spring ploughing only and in the sugar-beet experiment autumn ploughing only was given to some plots. The yields were compared with the remaining plots that received both ploughings. In each case double ploughing produced an increase: 5 cwt. of potatoes on a mean yield of 11.43 tons and 7 cwt. of beet on a mean yield of 15.36 tons, but in neither case did the cash value of the increase pay for the cost of the extra ploughing.

Seedbed Consolidation. Occasionally it is noted that crops show better growth over the tracks of tractor wheels than in between. In cereals the effect is sometimes strikingly shown by parallel bands of taller growth running across the field. The possible relation between compression of seedbed and plant growth requires much further study, and there is no obvious reason why it should be confined to cereals. For example, it was noted at Rothamsted that sugar-beet germinated better and grew more rapidly on an area that had been heavily consolidated in the previous winter by the passage of laden farm carts, and in 1934 and again in 1935, experiments were made to see the effect of heavy rolling of the seedbed for sugar-beet. An adequate measure of the percentage of germination was given by counting the number of plants per acre before harvesting. In 1934 there were about 3,000 additional plants per acre on the heavily rolled plots; nevertheless, the yield was 9 cwt. less than the mean of 14.03 tons p.a. In 1935, heavy rolling produced small reductions both in germination and in yield. Hence in neither year did the extra operation give any benefit.

Intensive Inter-row Cultivation of Root Crops. The root break is the cleaning crop in the rotation, and there is a common belief that beneficial effects on the yield are produced by inter-row cultivation in addition to the direct effect of weed eradication. In 1932, 1934 and 1935, five experiments were made to see whether extra inter-row cultivations improved yield. At Rothamsted three of the experiments were on sugar-beet and one on kale, while the remaining experiment, on sugar-beet, was done on the light, sandy soil at Woburn. The "normal"

cultivations consisted of hand, horse, or motor hoeing, sufficient to keep down weeds; the number ranged from two to five, depending on the season. The remaining plots were given an additional three to six hoeings after singling, again according to the season. The results were as follows:—

	Sugar-beet				Kale
	(1)	(2)	(3)	(4)	(5)
Mean yield, tons p.a.	13·5	15·4	11·9	11·6	25·5
Increase (+) or decrease (−) with extra hoeing	− 1·03	− 1·79	−0·23	+ 0·25	− 1·84

The figures are striking. In two of the experiments, Nos. 3 and 4, extra hoeings produced no appreciable effect on yield; in the remaining three a significant reduction of yield was the reward for the additional cost and labour of the extra hoeings.

Rolling and Harrowing of Cereals. These experiments were done on wheat in 1931 and 1933. Four comparisons were studied: harrowing alone, rolling alone, harrowing plus rolling, and no harrowing or rolling. In both years harrowing plus rolling gave the best results in grain yield: in 1931 a significant increase of 2.1 cwt. over the mean yield of 15.8 cwt. p.a., and in 1933, when the mean yield was 23.3 cwt. p.a., an increase of 1.4 cwt., which was, however, below the level of significance. In both years the yield of straw was slightly but insignificantly depressed by the combined operations. Harrowing without rolling produced the same effects on grain and straw yields as the combined operation, but to a smaller extent. Rolling without harrowing gave a small increase in grain yield, but an appreciable increase in straw yield. Hence, as far as these experiments go they give support to the practice of rolling and harrowing cereals.

Depth of Tillage: Rotary Cultivation. These two questions can conveniently be considered together as the results to be discussed were obtained from an extensive three-course rotation experiment (mangolds, barley, wheat) comparing the plough, the cultivator or grubber, and the Rototiller, each implement being used for shallow work (4 in.) on some plots and for deep work (8 in.) on others.

The main objects of this experiment, now in its sixth year, are to study the effect of depth of tillage on yield and to see

how far rotary cultivation can replace traditional methods. The cultivator or grubber was included as one of the main treatments, as its stirring action on the soil is intermediate between the inversion produced by the plough and the mixing action of the rotary cultivator. In addition, it was anticipated that the weed population of the plots would vary with the type of cultivation and thus provide information on both the efficiency of weed control under different cultivation methods and on the effect of weeds on crop yield.

The main results to date are as follows:—

Although crops have germinated quickest on the loose seed-bed prepared by rotary cultivation, this has conferred no advantage as far as the subsequent growth and yield are concerned. In fact there has been a slight tendency for ripening to occur earliest on the ploughed plots.

The yields of wheat, barley and mangolds have been about the same with all three methods of cultivation, provided the grubber or rotary cultivator are used for one year only. When employed for several years in succession the yield has sometimes deteriorated. The effect, however, is probably attributable to the increase of weeds, rather than to any direct defect in the type of cultivation. The practical conclusion is that in any year when time presses, quicker and cheaper cultivations can replace ploughing without any appreciable drop in crop yield.

Increased depth of cultivation has been without effect on crop yield, except for mangolds on the area devoted to continuous rotary tillage. Here the 8-in. depth of cultivation has kept the yields approximately to the level obtained on the ploughed plots, while on the 4-in. depth of rotary cultivation there has been a decline.

As would be expected, the grubbed and rotary cultivated areas have become more weedy than the ploughed area, but the effect on crop yield has not been appreciable except when these implements have been used for a number of years on the same area.

Conclusions. Under the soil and climatic conditions at Rothamsted little or no advantage is gained from cultivations above the minimum needed to obtain a reasonable seedbed and to check weeds during the early stages of crop growth. Deep cultivations such as subsoiling produce no increase of yield; intensive inter-row cultivations of root crops signifi-

cantly depress the yield. Ploughing can be replaced by the quicker and cheaper operation of cultivating or grubbing whenever time presses without appreciable detriment to the yield.

These results agree closely with work done elsewhere in different soil and climatic conditions and support the conclusion that cultivation has little influence on crop yields.

It is quite certain that at the present time most farmers will deny this conclusion, but the facts remain. The experiments have extended over a 12 years' period; the cultivations were all normal operations, done by skilled farm workers and controlled by a skilled farmer; they cannot be dismissed as unpractical experiments bearing no relation to farm conditions.

The very important question arises as to how far these results are representative for other soils. There is a probability, but no certainty, that they are typical for medium and heavy lands where the annual rainfall is less than about 35 in. It is therefore highly desirable that cultivation experiments should be made on as many different soil types as possible.

THE WATER NEEDS OF LIVE STOCK

CHARLES CROWTHER, M.A., Ph.D.,
Harper Adams Agricultural College

The part played by water in the living animal organism is so extensive and fundamental that the importance of an adequate and suitable supply can hardly be exaggerated. Excessive supply for a time may do little or no direct harm, but the avoidance of actual deficiency, even for short periods, must surely be regarded as one of the fundamental canons of efficient livestock husbandry.

At every stage in the development of the animal water forms by far the most abundant ingredient in the make-up of its body. In the unfertilized ovum of the cow, for example, the proportion of water will commonly be some 50-60 per cent., but after fertilization this rapidly rises through assimilation of water to 90 per cent. or more, from which high point it gradually falls as the embryo develops to a level of 75-80 per cent. in the body of the calf at birth, 65-70 per cent. at six months old, and an ultimate fairly steady 50-60 per cent. in the mature lean animal. At each stage of development the percentage of water will be considerably affected by the degree of fatness of the animal, the water-content of the body tending to fall as the fat-content increases, so that very fat animals may contain as little as 40 per cent. of water, at which level, nevertheless, it still remains the most abundant ingredient. Most of the soft tissues of the body, apart from the fatty tissue, will at all times contain from 70-90 per cent. of water.

When one bears in mind that water is being continuously lost from the body at a relatively rapid rate it is not surprising that lack of water should be far quicker in producing bodily breakdown and death than lack of food. It has been estimated that the body can lose practically all its fat and over one-half of its protein and yet live, whilst a loss of one-tenth of its water results in death.

The outstanding property of water in relation to the needs of the animal is its power of bringing into solution all the varied ingredients that the animal can utilize as food, and in such a state (ionized) as will facilitate their participation in

the various chemical reactions in the cells upon which vital activities depend. The water also manifestly serves as the means of transportation of materials in all parts of the body, and of waste products out of the body in the urine.

A further property of water that is of great importance is its high specific heat, which enables it to absorb large quantities of heat with a minimum rise of temperature, whereby the body is safeguarded against dangerous over-heating during periods of rapid heat-production. This effect is further strengthened by the high latent heat of vaporization of water, which makes it possible for large quantities of heat to be removed from the body in water vapour without change of temperature.

Apart from these basic solvent and temperature-regulating functions water also plays many other special rôles, more intricate in character, that are of great physiological significance. It is intimately associated with the solids of the body in colloid complexes in which some part of the water may be more firmly combined than the rest.

Although the greater part of the water required by the animal must be supplied through the mouth as drink and the moisture associated with the food, this does not by any means constitute the total supply of water that is available for the needs of the animal since a further amount (metabolic water) is produced in the course of the various chemical changes undergone by the carbohydrates, fats and proteins in connexion with the vital activities (metabolism). Thus, any carbohydrate that is fully oxidized in the body will yield about 60 per cent. of its weight of water, whilst the corresponding proportions arising from the oxidation of proteins and fats in similar circumstances will be 40 per cent., and over 100 per cent. respectively. Assuming these proportions, which could only be realized at maintenance or sub-maintenance levels of feeding, the maintenance ration of a bullock might theoretically produce about 4-6 lb. of metabolic water in the body. This "internal" source of water explains how it is possible for certain classes of animals to hibernate without external water supply. These animals gradually draw on their reserves of fat and carbohydrate to provide the necessary energy for maintaining their vital processes at a minimum level of intensity, and at the same time obtain through these changes sufficient water to replace that lost by respiration and evaporation, which under these conditions is also at a minimum.

The way in which various factors may operate to reduce water requirement to a minimum when necessary is also well illustrated by the ability of the camel to travel for long periods with little water. This is popularly attributed to the large water-holding capacity of the camel's stomach, but Babcock is probably more nearly right in tracing the phenomenon to the metabolic economy of the camel. Its food is mostly very low in protein and hence there is little urea to excrete and little production of urine necessary. It possesses a special reserve of fat in its hump and this on oxidation gives a high ratio of metabolic water production. Furthermore, the faeces are dry and the thick coating of hair reduces the rate of loss of water through the skin by evaporation.

The body's need for water is governed by many factors and is subject to wide variations for any particular individual over short periods. It is reduced to a minimum during periods of fasting, and reaches its maximum at the time of heavy production of watery materials, such as milk or eggs, that are removed from the body. In the latter instance the additional requirement beyond the normal needs of the body clearly cannot be much less than the amount of water in the product removed, and is probably considerably greater, especially in the case of heavy production.

Apart from the needs for the formation of such products and of body-tissue, much water is required to balance that lost by excretion through the lungs, skin, kidneys and intestines. These losses are highly variable according to the diet and other factors. The losses through the intestine, as represented by the amount of water voided in the faeces, vary with the species of animal. Thus the faeces of sheep are drier than those of cattle.

Similarly, the losses of water by way of the urine vary according to the forms in which the waste nitrogenous products are present therein. In mammals the principal product is urea, which is soluble in water and toxic to the tissues if the concentration is too high. The mammal, therefore, requires a relatively large amount of water to dilute the urea to a harmless concentration, remove it from the tissues and excrete it. Birds, on the other hand, excrete their waste nitrogen chiefly in the form of uric acid, which is of very low solubility and can be voided in a nearly solid form with a minimum loss of water. Other factors also tend to minimize the water requirements of birds, which, therefore, other

conditions being equal, are relatively lower than for mammals.

The heavy loss of water as vapour in the breath is obvious. This is greatly increased by physical activity and other factors which speed up the rate of respiration. Similarly perspiration through the sweat glands represents a patent loss of water which increases with rising temperature and muscular activity. Where, as in most animals, the sweat glands are few or absent the rôle of the lungs in the dissipation of heat through the evaporation of water assumes an enhanced importance.

Practical Water Requirements. From the foregoing it is clear that the water requirements of animals under the conditions of farm practice must vary widely with changing conditions even for the same class of animal, and general recommendations can therefore have only very limited value. Fortunately, with the healthy animal there are no deleterious effects from an excessive consumption of water, unless continued for a long time, so that practical needs are adequately met by making sure that the animals have the opportunity of consuming all they desire at frequent intervals. The automatic water-bowl, where available, is the best safeguard, and practical experience has shown that the provision of such continuously available water-supplies does not lead to the development of any habit of excessive drinking.

In experimental studies of water consumption it has usually been found that there is a rough correlation between the amounts of dry matter and of water consumed, including in the latter the moisture contained in the foods used. For most farm animals the ratio is usually in the region of three parts by weight of water to one part by weight of dry matter. The proportion of water varies somewhat with the nature of the food, tending to be higher with the more fibrous foods, such as hay and straw, than with the less fibrous grains and meals. Increase of protein-content of the ration also tends to raise water consumption owing to the greater volume of urine required to remove the increased amount of urea produced. Actual consumption from the bucket or bowl will, of course, be affected by the amount of water present in the food ration itself, rising and falling with the amount of succulent food included. Thus, in one of our own experiments, dry Shorthorn cows, each receiving 21 lb. hay daily, took from the bucket on the average about 70 lb. of water each. Replace-

ment of 1½ lb. hay by 14 lb. roots reduced the average amount of water drunk by about 10 lb., and this rate of reduction was maintained as successive quantities of roots were introduced into the ration in the above proportions, until with a food supply of 10-12 lb. hay and 80-90 lb. roots drinking water was taken only very irregularly and in very small amount. A rough allowance for the water-content of the food-supply can be made by assuming that succulent foods contain 75-85 per cent. and " dry " foods about 10 per cent. of moisture. There is no evidence that the " natural " water of foods has any nutritive superiority over that taken as drink.

The water requirement in proportion to liveweight also varies with the stage of growth in the case of young animals, being highest in the earliest stages (when the tissues are most watery), and falling steadily with advancing age to a relatively constant minimum at maturity. Thus, the suckling calf requires twice as much water per pound of liveweight as the full-grown ox; the suckling lamb more than three times as much as the adult sheep. Shortage of water-supply is thus most serious in the case of the young animal, and even a moderate shortage may cause serious retardation of growth in the case of the quicker-growing species, such as pigs and chickens.

Water Requirements of Pigs. According to American records the amount of water consumed by pigs on a diet of dry meals and water *ad lib* ranges from about 12 lb. daily per 100 lb. liveweight at weaning time, at, say, 30 lb. liveweight, down to 4 lb. or less per 100 lb. liveweight during the final fattening period, at, say, 200-250 lb. liveweight. This corresponds to a supply of about 3 lb. water per 1 lb. of meal for the weaner, and half this proportion at baconer weight, which is in fair agreement with British findings. In-pig sows require 8-12 lb. of water per day, but after farrowing far more is required, and according to data recorded at Cambridge (see this JOURNAL, Vol. XLIV. p. 999, January, 1938) as much as 40-50 lb. daily may be taken, if given the opportunity, by the sow suckling a strong litter.

Water Requirements of Beef Cattle. An adequate supply of water is important for fattening cattle, especially in the younger stages when both growth and fattening have to be secured. The actual amount required as drink will naturally

be considerably affected by the amount of succulent food in the ration, but taking this into account the total supply for 2-year-old cattle (and dry cows) should not be less than 70-100 lb. per head daily. In American tests young beef cattle, averaging about 800 lb. liveweight, drank 6½-7 gal. of water per head daily in winter, and 7-8 gal. per head in summer.

Water Requirements of Milch Cows. An abundant supply of wholesome water is indispensable for successful milk production. As indicated above the cow of average size needs some 70-80 lb. of water daily for the needs of her body quite apart from the secretion of milk, of which every gallon removes some 8½-9 lb. of water from the body. The basic water requirement will thus increase by at least a gallon, and probably more, for each gallon of milk produced. With an average milk-yield of 2 gal. per head the average daily water-supply (in drink and food) should certainly therefore not be less than 10 gal. per head, and probably 12 gal. would be a better working standard. For higher milk-yields this figure should be raised by 1½-2 gal. for each extra gallon of milk produced. These figures can only be a rough guide, since the amount of water cows will actually take depends also on their size, on the temperature and humidity of the air, and on other factors. The whole requirement for "maintenance" and milk production will usually average about 4-5 lb. of water for each 1 lb. of milk produced.

The best method of "watering" the high-producing milch cow is undoubtedly the automatic drinking bowl, since this not only ensures a sanitary supply and saves labour, but it also enables the cow to get its water in frequent small instalments, rather than in deep draughts at long, and often irregular, intervals. Where drinking bowls are not used cows should be watered at least twice a day, especially in the case of high producers. In American experiments good cows watered from drinking bowls produced about 4 per cent. more milk than those allowed to drink all the water they would take twice a day, and 6-11 per cent. more than those watered once a day. In the case of low producers the differences were negligible. In these experiments it was noted that the cows provided with bowls drank on the average about 10 times each 24 hours, and about one-third of the water was taken during evening and night hours.

Water Requirements of Poultry. Few data are available as to the water consumption of poultry at various stages. In German experiments with White Leghorn chicks the daily water consumption rose from an average of 12 grm. per head in the first month to 80 grm. in the third month, after which it remained relatively constant at 65-75 grm. up to the end of the fifth month. Another group receiving its water solely as separated milk showed similar averages after the first month, and also showed the peak of consumption in the third month. The latter phenomenon, however, may have been merely a consequence of the hot weather said to have prevailed during the first twelve weeks. For the adolescent bird up to the point of sexual maturity we are probably not very wide of the mark in assessing its water requirement from all sources (water trough, grass, grain and mash) at about twice the weight of dry food fed.

With the onset of egg-production, however, the water needs of the bird must necessarily rise, since nearly three-quarters of the egg consists of water, or, in other words, each 2-oz. egg removes nearly $1\frac{1}{2}$ oz. (about 40 grm.) of water from the hen's body. Assuming that something like double this amount of water must be taken by the bird to ensure the 40 grm. required to be incorporated in the egg, and that in addition the bird will have a maintenance requirement of, say, 170 grm. per day (85 grm. food $\times$ 2), we arrive at an estimated total daily water requirement of about 250 grm. for the case of 100 per cent. egg production. German data suggests that this estimate is probably reasonable, since in a six-months test, from February to August, with White Leghorn pullets kept semi-intensively and receiving only separated milk to drink, the average amount drunk daily was about 240 grm., with an average level of egg production about 65 per cent. Naturally the actual consumption fluctuated widely from day to day and on occasion reached 300 grm. Having regard to the probability that birds will probably drink separated milk rather more freely than water, it cannot be far wide of the mark to take a round figure of 200-250 grm. per day (= 1 gal. per 18-22 hens) as the average amount of water likely to be taken by the hen in average production when an unrestricted water supply is available.

LOSSES BY DEATHS, DEPRECIATION, AND REDUCED PRODUCTION IN POULTRY FLOCKS

J. H. SMITH, M.Sc.,

Department of Agricultural Economics, University College of Wales, Aberystwyth

During the last ten years there has been a general deterioration in the health and stamina of laying flocks, and managers are finding it increasingly difficult to maintain the size of their enterprises. Each year, deaths, together with culling and selling, reduce the size of laying flocks to less than half their original numbers. In addition to the financial losses there is considerable wastage of housing accommodation, of plant and equipment, and the evidence indicates that production is reduced to 75 per cent. of capacity. The financial costs of deaths and of depreciation and the loss in production amount to nearly 4*s*. for each bird in the flocks at the beginning of the accounting year.

TABLE I—MOVEMENT OF BIRDS INTO AND OUT OF LAYING FLOCKS

	1934–35		1935–36		1936–37	
No. of Flocks	14		24		29	
	No	Percentage of Total	No	Percentage of Total	No	Percentage of Total
Old Hens .	1,965	55 79	3,663	47·65	4,251	44·31
Pullets	1,557	44·21	4,025	52·35	5,343	55·69
TOTAL INTAKE	3,522	100·00	7,688	100·00	9,594	100·00
Deaths	562	15·96	1,134	14·75	1,606	16·74
Sales	1,115	31 65	3,032	39·44	3,669	38·24
BIRDS STILL IN FLOCKS .	1,845	52·39	3,522	45·81	4,319	45·02

Some very interesting information on deaths and sales has been collected from poultry enterprises in Wales during the last three years. The enterprises studied include large and small flocks on general farms and also some small backyard flocks and large special farms. In all instances managers were keenly interested in their poultry enterprises, though in

some the general standard of management was not good. As a sample they may be considered representative of the better class of flocks raised on general farms and specialist commercial egg farms. Not all managers made monthly records of the deaths and sales, and Table I shows the general information for those giving full information.

It will be seen that the death-rate has varied from 15 to 17 per cent., while culling and selling has varied from 32 to 39 per cent. on the average of all flocks. The total deaths and sales have varied from 48 per cent. in 1934-35 to 55 per cent. in the following two years.

Continuous records for ten farm flocks over the three years show the same general results. The average size of the laying flocks at the beginning of October, 1934, was 328, and by the end of the following September it had been reduced to 179. Young pullets were added to bring the average strength up to 317, but during the following year the number had again declined to 158. Pullets were again added and the average size at the beginning of October was 310, but by September, 1937, it had fallen to 165.

Managers cull birds from their laying flocks continuously throughout the year, but the seasons of heaviest culling are in the late autumn after the pullets have come into lay, in the spring, especially at Easter time, and during the late summer and early autumn. Early winter culling is done mainly to remove unproductive pullets, while spring culling is prompted chiefly by the better prices offered for boilers and the low price of eggs. During the late summer and early autumn, managers dispose of older birds occupying accommodation required by pullets.

The risk of losses by deaths steadily increases between October and the spring, but from then until September remain fairly steady. Losses by deaths are often avoided by culling and sales and this is largely responsible for the small variations in the monthly death-rate.

Relationship between Deaths and Sales. Under conditions in which death-rates below 20 per cent. are experienced, there is a direct opposite association between deaths on the one side and culling and selling on the other, for as the death-rate rises the rate of culling and selling falls, and *vice versa*. With normally healthy stock, the chief purposes of culling are the need to dispose of unproductive birds and to provide accom-

modation for new stock, but when flocks are seriously affected by disease it becomes necessary to cull heavily in order to avoid complete losses by deaths. The cases showing abnormally high death-rates also show very heavy culling and selling. Table II shows the relationship between deaths and sales when the records are placed in groups of high and low death-rates and in groups of high and low selling-rates.

TABLE II

	Death-Rates		Selling-Rates	
	Over 13 per cent.	Under 13 per cent	Over 35 per cent	Under 35 per cent.
No of Flocks	34	33	32	35
	Percentage	Percentage	Percentage	Percentage
Original Flock				
Hens .	46·9	48·1	47·3	49·8
Pullets .	53·1	51·9	52·7	50·2
	100 0	100 0	100 0	100·0
Deaths	22·9	8·9	13·0	19·0
Sales .	35·0	40 1	50 3	23·7
Birds Still in Flocks .	42·1	51·0	36 7	57 3
	100·0	100·0	100·0	100·0

The simple interpretation of these results is that owners of flocks with a low death-rate had older birds to sell, while owners of flocks with high death-rates had to sell large numbers of pullets as well as the older birds in order to avoid heavy losses. The owner of a flock of 100 laying birds with a death-rate of 5 per cent. may sell 45 birds during the year; if his death-rate increases to 10 per cent. his sales will fall to 40 birds. But when the death-rate gets as high as 20 per cent., the sales may still be as high as 40 per cent. and if the death-rate increases to 30 then the owner may sell the remaining 70 per cent. and make a fresh start with new stock and fresh land.

Losses in Egg Production. The records show that the average productive life of birds is less than 18 months. Many of the losses by deaths and culling occur at seasons when fresh birds are not available, and this results in some wastage of

housing accommodation. In each of the last three years, the estimated loss in egg production has ranged from 26 to 30 per cent. of what would have been possible if all the birds remained in the flocks for two years or until other birds were available to take their places. The losses resulting from deaths have remained about the same in each of the three years, but the losses from birds sold are increasing in importance. Table III shows the estimated losses in each of the last three years.

TABLE III.—ESTIMATED REDUCTION (PERCENTAGE) IN EGG PRODUCTION DUE TO DEATHS AND SALES

Year	*Deaths*	*Sales*	*Total*
1934–35 . . .	8·7	16·6	25·3
1935–36 .	8·4	19·9	28·3
1936–37	9·4	20·3	29·7
ALL YEARS . . .	8·9	19·5	28·4

Against this estimated loss in production there has been some saving in expenditure, but the only important item that would show any substantial reduction in its total cost as a result of reduced numbers of birds is feeding stuffs. Table IV shows that the gross loss of income in each of the last three years ranged from 3*s*. 6*d*. to 4*s*. 9*d*. for each bird in the flocks at the beginning of the accounting year.

TABLE IV.—ESTIMATED LOSS OF OUTPUT PER BIRD IN THE ORIGINAL FLOCKS

Year	Gross Loss	Saving in Feeding Stuffs	Net Loss
	s. d.	*s. d.*	*s. d.*
1934–35 .	3 6	1 11	1 7
1935–36 . .	4 0	2 0	2 0
1936–37	4 9	2 5	2 4
ALL YEARS . .	4 3	2 2	2 1

If all the birds had remained in the laying flocks, the additional expenditure on feeding stuffs would have amounted to just over 2*s*. per bird. When this saving is deducted from the gross loss, the net loss of output in each of the three years ranged from 1*s*. 7*d*. to 2*s*. 4*d*. per bird.

Costs of Deaths and Depreciation. The attention of managers is directed mainly to the incidence of deaths, but

under present conditions and methods of management the depreciation in the value of birds which remain in the laying flocks until they are sold is of greater importance. On the basis of market values of pullets and old hens culled from laying flocks, the cost of depreciation amounts to at least 3*s.* per bird, while if the bird dies there occurs a further loss of about 2*s.* The important consideration is the total annual cost of deaths and depreciations. On assuming a cost of 5*s.* for breeding and rearing pullets, the cost of deaths and depreciation in each of the last three years ranged from 1*s.* 8*d.* to 1*s.* 10*d.* per bird in the flocks at the beginning of each year, and from 2.72*d.* to 2.96*d.* for each dozen eggs produced. The separate statements for each year are shown in Table V.

TABLE V.—COSTS OF DEATHS AND DEPRECIATION

	1934-35	1935-36	1936-37
PER BIRD IN THE ORIGINAL LAYING FLOCKS	*d*	*d*	*d*
Deaths	2·59	3·21	3·77
Sales .. .	17·70	17·63	18·49
TOTAL . .	20·29	20·84	22·26
PER DOZEN EGGS			
Deaths	0·38	0·42	0·49
Sales	2·58	2·30	2·39
TOTAL . ..	2·96	2·72	2·88

Costs immediately arising from deaths are assumed to be equal to the loss of the value of the birds as "boilers," while depreciation is estimated as the difference between an original value of 5*s.* and the value of each bird as a "boiler." The increase in the numbers of birds sold or lost by death is reflected in the higher costs per bird. There was no substantial change in the importance of the cost per dozen eggs, the effect of the higher cost per bird in the last year being offset by higher egg yields.

The net loss in production and the costs of deaths and depreciation amounted to 3*s.* 3*d.* for each bird in the laying flocks at the beginning of the 1934-35 accounting year. In the following year, the total sum was 3*s.* 9*d.*, and in 1936-37 it had increased to 4*s.* 2*d.* per bird. It is difficult to judge what reduction could be made in these figures, but by concerted efforts at eliminating poultry diseases, or a general improve-

ment in those circumstances which necessitate heavy culling, it should be possible to reduce the cost and increase the revenue. Taking as standard an annual death-rate of 5 per cent., an intra-seasonal selling-rate of 10 per cent., and an annual yield of 144 eggs by each bird completing a recording year, the total annual production will amount to about 133 eggs for each bird in the flock at the commencement. The loss in the value of output will amount to 6*d.* per bird, and, assuming the original flock consists of equal numbers of pullets and older birds, the cost of deaths and depreciation will amount to about 1*s.* 7*d.* and the total cost and loss to 2*s.* 1*d.* per bird. It will be seen that this cost of death and depreciation does not differ greatly from that shown in the records, but such total cost is only half the amount shown for 1936-37. The higher costs occur only when the losses become so great that a very large proportion of pullets must be added each year to maintain the normal strength of the flock. Two flocks, each starting every year with equal numbers of pullets and hens of equal value, but one having a death-rate of 10 per cent. and the other one of 20 per cent. will show differences in the cost of deaths and depreciation of only 2.4*d.* per bird. If, however, the flock with the higher death-rate starts each year with 70 per cent. of pullets, then its stock costs will be nearly 10d. per bird higher than that for the other flock. The real point of importance is the loss in production, and the records show losses in production ranging from 1*s.* 1*d.* to 1*s.* 10*d.* in excess of that shown for the suggested standard flock.

Under conditions prevailing amongst many commercial enterprises in Wales profits are being limited both by increase in stock costs and by loss of revenue. There is naturally a very close association between the general health of flocks and egg production. Owners of unhealthy or defective stock have high stock costs due to the necessity of raising a large number of chicks to replace hens removed by deaths and culling, and suffer heavy losses in revenue due to low production per bird and also to the fact that fresh hens do not immediately replace those removed.

Not all birds culled and sold from laying flocks are defective, especially those sold in the spring. In some districts it is possible to obtain from 1*s.* to 1*s.* 6*d.* per head more for birds sold in the spring than for those sold in the autumn, and this difference may be greater than the profits earned in egg production during the summer.

The margin between direct costs in feed and attention labour and value of eggs produced is wider during the months May to September than in the later months of the year, and this margin assists in covering the indirect costs of rearing stock, housing costs, rent, etc., and contributes largely to the profits of the year. Some managers are unduly influenced by the low prices of eggs in the spring and do not take sufficient account of the monthly yields per bird. The total value of the eggs produced by good productive stock during the spring months will exceed the direct costs of production, and unless the spring values for such birds are appreciably higher than those obtainable in the autumn the birds should be retained until pullets are ready to take their places. As an indication it may be stated that a hen which produces 65 eggs between April and September adds to the profits of the flock, and if such a bird is sold in the spring it should realize at least one shilling more than its autumn value if profits are not to be sacrificed.

VOX AGRICOLAE !

A. V. Campbell

The attitude towards agricultural education in all its phases has undergone marked changes during the last few years. Those who have blazed the trail can, while deriving some small satisfaction from the beneficial results of their labours from an economic point of view, rejoice in the development of the more aesthetic side. This has as its objective the pursuit of happiness in the daily round and common task through the better appreciation of the many problems of rural life resulting in the ability not only to live, but enjoy to the full those pleasures which emerge from health and understanding and from the social contacts made during their acquisition. The fruits of labours directed towards this end are beginning to be apparent in some of the more recent social developments of Young Farmer Club activities.

The problems and difficulties of State-organized education are recognized and appreciated. With this fundamental phase of education, however, this article is not concerned so much as with the directions and contributions which voluntary study through the many Young Farmers' Clubs scattered throughout the country is making towards the stimulation of thought, enterprise and understanding which contribute to the art of living and enjoyment of a full life in the countryside. The exposition of this educational creed, while being primarily the concern of country dwellers, has in it the making of a story which concerns not only the primary producer but those in country towns whose life is linked up closely with the requirements and prosperity of the farm. Indeed, the story is worthy of even wider publicity. Its exponents of to-morrow are the young farmers of to-day. Suitably encouraged and educated in the art of exposition, they represent a valuable force which may penetrate even into the towns, direct attention to their calling, and ensure that the city dweller is conversant with and appreciative of their lot.

The recital, however, is difficult and demands practice both in the control of nerves and the effacement of self-consciousness.

Nevertheless, if there is a story to tell and the telling is worth while, instruction in the art of telling, though difficult, is of the first importance. It is, moreover, an art in which some facility may be attained by practice that gives opportunity for ample criticism.

The value of giving opportunities for practice and development in the "art of speaking in public," which is necessary not only for the conduct of rural affairs but in order that the countryman may get a sympathetic hearing in a wider sphere, has been seized upon by the Directors of the *Darlington and Stockton Times* newspaper, who, realizing the value of clear thinking and the clear expression of thought by speech in a manner which compels attention, have organized speech-making competitions for cups and other valuable prizes among the Northern County Federations of Young Farmers' Clubs.

The first round takes place in the clubs themselves, the adjudicators being the audience. In this preliminary stage the choice of subjects is left to speakers. The object of this is twofold On the one hand, variety of subjects makes for added interest for listeners, while on the other, it enables speakers to be drawn out and obtain confidence through facing an audience and discussing a topic in which they are particularly interested. Often at this stage the speeches may be little more than recitals or records of personal interests and subjects may range from "Potato Growing" to "Observations on Birds," or the "Keeping of Guinea Pigs."

Each club nominates two speakers to uphold it at the preliminary inter-club contests which provide the main eliminating round, and it is not uncommon for upwards of a score of budding speakers of both sexes to present themselves for hearing. At this stage of the competition an audience is welcomed; but, since even an audience must tire, sessions are arranged at which not more than six or seven speakers are heard. Here, again, the freedom of choice of subjects is allowed, but it is stipulated that they must be of "agricultural interest." From these preliminary rounds the best half-dozen speakers are chosen to go forward to the County Federation Finals at which speeches are made against a time limit, usually of 10 minutes, from a list of subjects of which notice has been given. It is usually arranged that this list covers the subjects selected by speakers in the eliminating rounds. This rule is one of expediency since it reduces to a minimum the amount of work required in preparation and allows for and encourages

polish, correction, and amplification of points made in speeches already delivered, and at the same time assists in promoting confidence.

At the finals the order of speaking is determined by lot. The stage is set with a chairman and timekeeper. Normally there are three adjudicators. Two of these are mainly concerned with the subject matter, for, if the contests are to be of any lasting value, it is absolutely necessary to discriminate between sound knowledge and the showy speech supported by " slick " repartee; the interest of the third adjudicator is confined to elocution and style.

The judges sit at a table towards the middle of the hall. At the end of a speech, fair but probing questions are asked by the adjudicators. Adjudication is of the greatest importance, and on it hangs the whole future and, one might say, value of the project. It is an art in itself, for not only is it necessary to probe the depth of knowledge of a speaker but also to give encouragement and draw out the witty or serious answer often to the entertainment of the audience who derive some amusement from the occasional bantering. For there is an audience. At the finals of the Yorkshire and Durham competitions a total of over a thousand people attended, and it is held by many north countrymen that nothing has brought the Young Farmers' Club movement into favour with the *general* public to comparable extent.

Indeed, the movement is gathering momentum. The first contest in the north was held at Darlington in March, 1935, in which Durham clubs took part. This is believed to have been the first held in this country. It was followed by a similar contest in 1936. In view of the success which greeted the venture, and in response to requests made by the clubs in the North Riding of Yorkshire, a competition at Northallerton was arranged in 1937. Competitions at both these centres were held in 1938 and will be held again in 1939. Keenness grows and so does the audience. At the end of the speeches, the judges, after awarding marks, comment on the competitors, and in doing so offer valuable advice and constructive criticism. When one considers the desirability and necessity for the farmer to be able to express adequately his views and grievances, it must be conceded that the co-operation of press and club can do much to further the social objectives which are the ardent wish of every farmer. The example set by the *Darlington and Stockton*

Times is commended to the management of other contemporary journals.

Already it is understood that similar contests in Northumberland are being projected by another northern paper. While being of particular interest to those whose business it is to keep the country informed, the stimulation of such work could advantageously be shared by others.

One cannot leave this question without being tempted to enquire: What next? Having proceeded by way of local contest to proclaim area champions, the thought naturally occurs to many as to whether from among them it might be expedient to make selections to go forward to a National Competition. Reflection on the question, however, suggests that apart from the almost overwhelming difficulties which would arise should the movement expand, little would be gained by maintaining such an objective, and that in striving for it the real value of the contests might be overlooked by reason of the fact that such an extension would tend to direct undue attention to the individual, whereas it is the fostering of the team spirit which needs encouragement. Fortunately, there is no lack of ways in which successful individuals can be called upon to uphold their Clubs and Federations. The county contests should therefore be regarded in their proper perspective—as educational media for the preparation of individuals as a necessary prelude to the selection of teams which might meet in inter-county debates. The value of this phase has already been recognized, and in 1933 the first inter-county debating contest took place in Northern Ireland, culminating in a final contest for cups offered by the Imperial Chemical Industries Co., held at Queens University, Belfast, and attended by the Prime Minister and Minister of Agriculture.

If, as suggested earlier in this article, it is desirable to tell the story of the farm either directly or in debate to the largest audience, judiciously chosen inter-county debates broadcast by radio would appear to offer opportunities of almost unparalleled excellence.

A COMPARISON OF SOOT AND SULPHATE OF AMMONIA AS SOURCES OF NITROGEN FOR THE BRUSSELS SPROUTS CROP*

F. HANLEY, M.A.,
School of Agriculture, Cambridge

Introduction. In 1933 the Horticultural Section of the Eastern Counties Provincial Conference commenced experiments in which soot and sulphate of ammonia were compared as sources of nitrogen for the Brussels sprouts crop. The basic scheme at each centre consisted of four treatments each replicated four times in a 4 × 4 latin square, viz:—

TREATMENT	1.	No nitrogenous fertilizer
,,	2	Soot at 1 ton per acre.
,,	3	Sulphate of ammonia supplying the same amount of nitrogen as Treatment 2
,,	4	Soot at 1 ton per acre plus sulphate of ammonia as for Treatment 3

Source of Soot. It is common experience to find wide variation not only in the nitrogen content of different consignments of soot, but also between individual bags of the same consignment. In each season, therefore, arrangements were made for the thorough mixing of a sufficient quantity of soot to supply all experimental centres.

The nitrogen content of the soot used was as follows:—

Season	*Nitrogen Content of Soot*	*Quantity of Sulphate of Ammonia supplying same Amount of Nitrogen as 1 ton of Soot*
	%	cwt
1934–35	5.50	5.34
1935–36	4.61	4.47
1936–37	4.87	4.73

* This report has been prepared for publication at the request of the Horticultural Section of the Eastern Counties Provincial Conference. The field work in connexion with the experiments was carried out by the Horticultural Instructors of the following counties: Bedford, Cambridge, East Suffolk, Hertford and West Suffolk. The thanks of the conference are due to those growers who provided land, labour and other facilities for the conduct of these experiments.

Application of Fertilizers. In each of the three years a basal dressing equivalent to 6 cwt. per acre of superphosphate (14 per cent. P_2O_5) and 2 cwt. per acre of sulphate of potash, was worked into the soil before the Brussels sprouts were planted out. Dung was applied at only two of the fourteen centres.

The full quantity of soot was applied in one dressing, usually before the sprouts were planted out. It was felt that, in commercial practice, sulphate of ammonia would usually be divided into two or more applications and so, in 1934, one-third was applied at the same time as the soot, and the remaining two-thirds in two equal top dressings later in the season.

In 1935 and 1936 the sulphate of ammonia was applied in two equal dressings, half at the same time as the soot, and the remaining half in July.

The application of soot near the time of planting was criticized by some growers as being too late in their districts. To meet this criticism the Organizer for Bedfordshire carried out a separate experiment in the season 1936-37, comparing three times of application of soot. The results of this trial provided no support for this criticism of the main trials.

Variety of Sprouts. In the first season the growers' own plants were used on the experimental plots, but in subsequent seasons, seeds or plants were kindly supplied by Mr. Boyes, Director of the Cambridge Horticultural Research Station, from a strain bred at the Station. In 1935 an early maturing strain (33. ST. 1) was supplied, whilst in 1936 a mid-season strain (35. ST. 5) was used. The plants were raised in seedbeds and then planted out, usually 3 ft. × 3 ft. At Centre H in 1936-37 the spacing was reduced to 2 ft. × 2 ft. It is interesting to note the high yield at this centre and the large response to nitrogenous fertilizer; on the plots receiving the double dressing the total yield was 8 tons 12 cwt. of saleable sprouts per acre. The question of the best spacing for the modern, more dwarf strains of sprouts seems worthy of closer investigation.

All plots contained the same number of plants at the outset (usually 64-120 according to the size of plot) and, as is customary in most districts, any plants that died during June and July were replaced by other plants kept in reserve for the purpose.

TABLE I.—DESCRIPTION OF EXPERIMENTAL CENTRES

Centre	Soil	Geology	Previous Crop	Usual Cropping	Remarks	Sprouts Planted
C 1934	Chalky Loam	Chalk Marl	Sugar beet	Farm crops with occasional Brassicae	Very dry weather from planting up to August	April 26
B 1934	Sandy Loam	Lower Greensand	Green Peas	Market garden Crops	Limed for 1934 Sprouts. All soot and S Ammonia applied *after* planting	May 15
H 1934	Light Loam (gravelly)	Glacial Sand and Gravel	Winter oats followed by rye cut for ensiling in May 1934	Farm Crops	All soot and S Ammonia applied *after* planting, the dressings being half those at other centres	June 15
E S 1934	Sand	Glacial Sand	Cabbage and Cauliflower	Chiefly Market garden Crops	Dung was applied for 1934 Sprouts crop. Weather dry for long time *after* planting	June 7
W.S 1934	Heavy Loam	Boulder Clay	Oat	Farm Crops	—	June 6
B 1935	Clay Loam	Boulder Clay	Barley	Farm Crops	All soot and S Ammonia applied after planting	Early June
C 1935	Chalky Loam	Chalk Marl	Seeds Hay (received dung at 6 tons p a)	Farm Crop, occasional Brassica	Dung at 10 tons p a for 1935 sprouts. Severe frost in November seriously damaged many plants denuded of leaves by careless picking early in the season	May 22
E S 1935	Sand	Glacial Sand	Spring Cabbage received dung	Potatoes and Market garden Crops	Very slight attack of Club Root	May 24
H 1935	Gravelly Loam	Glacial Sand and Gravel	Market garden Crops	Mixed Farm and Market garden Crops	All soot and S/A applied *after* planting. Plant establishment below standard of other centres	May 24
B 1936	Sandy Loam	River Gravel	Barley	Farm Crops	All soot and S/A applied *after* planting	June 8
C 1936	Chalky Loam	Chalk Marl	Cereals	Farm Crops, occasional Brassicae	—	June 3
H 1936	Fine Sandy Loam	Glacial Sand and Gravel	Wheat	Grass used for poultry runs for some years	Plants spaced 2 ft by 2 ft	June 4
E S 1936	Sand	Glacial Sand	Potatoes	Sugar beet in 1934 following several years in Lucerne	No firm sprouts ready to pick at first (October) picking on plots that received no nitrogen	June 10
W S 1936	Heavy Loam	Boulder Clay	Barley	Farm Crops	Only one picking and that early in the season	June 9

N B —In this and all other tables centres are distinguished by the initial letters of the County concerned (see footnote p 671)

TABLE II

SUMMARY OF RESULTS FOR THREE SEASONS, 1934-36 INCLUSIVE

YIELDS OF SALEABLE SPROUTS (CWT PER ACRE)

Centre	1934-35 B	1934-35 C	1934-35 H	1934-35 ES *	1934-35 WS	1934-35 Mean	1935-36 B	1935-36 C*	1935-36 H	1935-36 ES	1935-36 Mean	1936-37 B	1936-37 C	1936-37 H	1936-37 ES	1936-37 WS	1936-37 Mean
Yield without Nitrogenous Fertilizer	74 59	77 76	36 50	52 76	49 44	**58 21**	24 77	39 95	26 40	57 15	**37 06**	46 87	85 62	111 3	34 47	8 02	**69 56†**
Increase in Yield due to Soot alone	+7 14	+0 53	+7 10	−2 02	+11 42	**+4 83**	+2 67	+1 0	+10 2	+14 85	**+7 18**	+18 85	+13 28	+40 1	+23 9	+7 15	**+24 83†**
Increase in Yield due to S/Ammonia alone	+8 81	+6 97	+20 85	+7 20	+19 35	**+12 64**	+3 9	−0 45	+2 4	+13 05	**+4 72**	+18 98	+14 75	+36 7	+27 57	+11 53	**+24 50†**
Increase in Yield due to Soot + S/A together	+3 24	+9 48	—	−1 12	+25 54	—	+2 0	−3 27	—	+21 6	—	+26 45	+20 60	+61 0	+22 42	+17 08	**+32 62†**
Yield from S/A alone *minus* Yield from Soot alone	**+1 67**	**+6 44**	**+13 75**	**+9 22**	**+7 93**	**+7 81**	**+1 23**	**−1 45**	**−7 80**	**−1 80**	**−2 46**	**+0 13**	**+1 47**	**−3 40**	**+3 67**	**+4 38**	**+0 47†**
Standard Error	*4 22*	*2 03*	*0 87*	*3 23*	*2 91*	—	*1 1*	*4 33*	*2 56*	*2 59*	—	*1 66*	*2 05*	*3 76*	*6 48*	*1 60*	—

* Received dung for the Brussels sprouts crop

† Does not include Centre W S where only one picking was made In view of the early cessation of picking at this Centre, the data have not been included in the general discussion of this table

N B —To be statistically significant, differences between yields from any two treatments should exceed 3 times the standard error shown in the table for that centre Effects underlined with a single line are statistically significant Underlining with a double line indicates that the double dressing of nitrogen was significantly greater than either single dressing In 1935-36, results at Centres B and H were not significant at the preliminary "Z" test

Weather. In 1934 some difficulty was experienced in planting out under the dry conditions of May and June, and at most centres early growth was restricted by the lack of moisture during June and July. Conditions later in the season, however, were fairly favourable to growth.

In 1935, April was wet and May cold, with drying east winds, followed by a wet period in early June. July and August were dry and hot though there was adequate rainfall towards the end of August. September and October were good growing months with high rainfall but were followed by an exceedingly wet winter with rather severe frosts as early as November in some places. Yields at the experimental centres were rather low and response to nitrogenous fertilizer was less than in the other two seasons.

In 1936, April and May were dry and cold, but were followed by a wet period during early June. With the exception of a dry spell in August the remaining summer months were rather wet. In the autumn and winter, growing conditions were generally good. Yields and response to nitrogenous fertilizers were much larger this season than in the previous two years.

Observations and Yields. Observations on the growing crop were singularly lacking in interest. At most centres the effect of nitrogen, whether as soot or sulphate of ammonia, led to the production of more profuse or darker green foliage. At a few centres plants on the soot plots appeared to carry darker foliage than plants on the sulphate of ammonia plots during late July and early August, possibly because the second half of the dressing of sulphate of ammonia had not had time to become fully effective. From September onwards, however, all observers reported that it was impossible to distinguish, by inspection of the plants, which plots had received soot and which sulphate of ammonia.

The produce was graded into the two usual grades, viz., "blowers" and "saleable sprouts." Examination of the saleable produce failed to disclose any difference between the colour and firmness of sprouts receiving soot and those receiving sulphate of ammonia. This is contrary to the view held by many growers, that soot helps the production of a more attractive product, but all observers in all counties were unanimous that no such difference could be detected in these trials.

At all centres the application of one or other of the nitro-

genous dressings led to an increased yield, the increase being statistically significant at 8 of the 13 centres. It is reasonable to suppose, therefore, that if there is any substantial difference between the merits of these two different sources of nitrogen, some indication of this should be forthcoming from these experiments. The difference between the yields from soot and sulphate of ammonia, however, only reached statistical significance on two occasions, both these being in favour of sulphate of ammonia and both occurring in the season 1934-35.

Table III shows the mean response to soot alone and to sulphate of ammonia alone:—

TABLE III

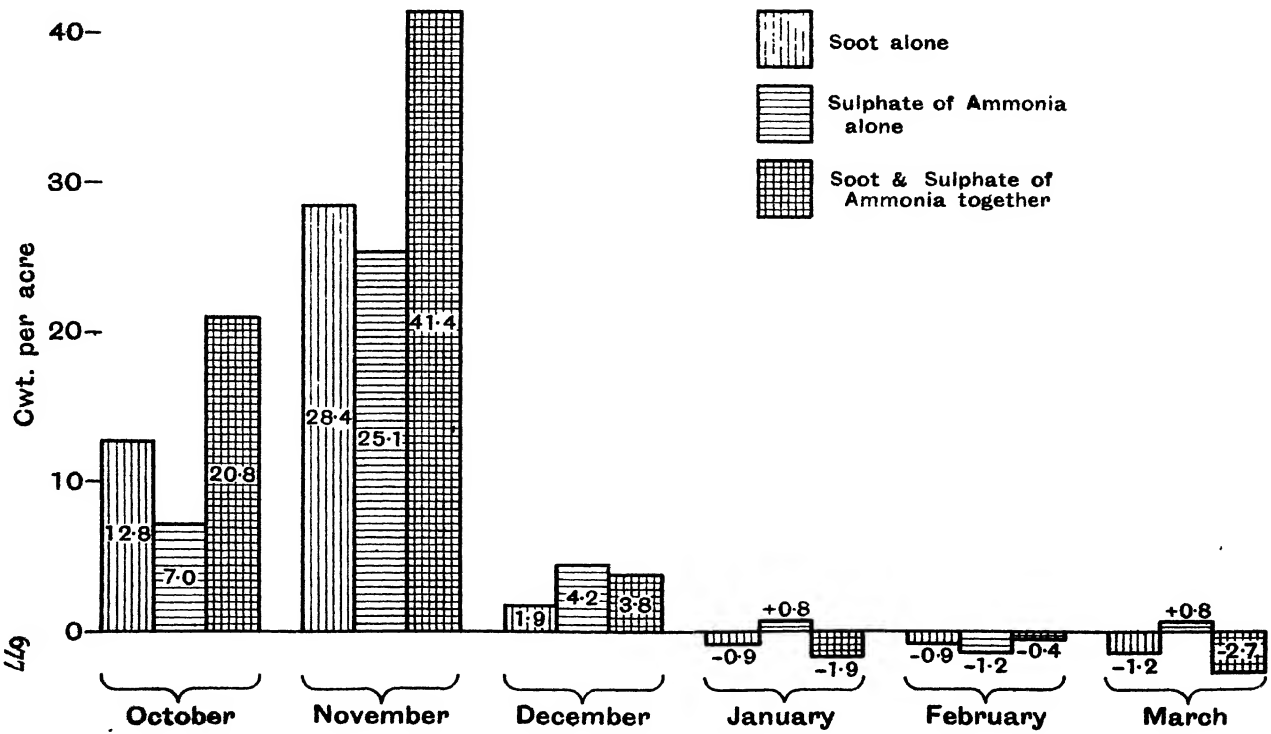
Season	*Increase in Yield (cwt per acre) from* Soot Alone	*Increase in Yield (cwt per acre) from* S/Ammonia Alone
1934 (mean of 5 centres)	4·83	12 64
1935 „ 4 „	7 18	4 72
1936 „ 4 „	24 03	24 50
Mean of annual increases	12 01	13 95

The figures for the mean of the annual increases in yield represent the average increases due to the application of 1 ton of soot or 4.85 cwt. of sulphate of ammonia respectively By assigning local prevailing prices to the manures and the sprouts, an estimate can be made of the profitableness of the expenditure on each of these fertilizers.

Distribution of Response to Nitrogen. The response to soot came neither earlier nor later in the season than that to sulphate of ammonia. Considerably more than half the yield increase was obtained before Christmas, even when picking continued into March. The distribution of the response to double nitrogen was similar to that from single nitrogen.

The diagram opposite shows the response to both single and double nitrogen at individual pickings at Centre H in 1936, where single nitrogen gave a significant increase over no nitrogen, and double nitrogen a significant increase over single nitrogen.

The distribution of response to nitrogen shown in the diagram is typical of the experiments as a whole. Hence, under the conditions of these experiments, both single and double dressings of nitrogen produced their greatest effects on yield during the first half of the picking season. The possible effect of varying the time of application of nitrogen, however, has


40
30
20
10
0
Cwt. per acre
Soot alone
Sulphate of Ammonia alone
Soot & Sulphate of Ammonia together
12·8
7·0
20·8
28·4
25·1
41·4
1·9
4·2
3·8
-0·9
+0·8
-1·9
-0·9
-1·2
-0·4
-1·2
+0·8
-2·7
October
November
December
January
February
March

not been overlooked and is the subject of further experiments now in progress.

Comparison of Responses to Single and Double Dressings of Nitrogen. The double dose of nitrogen gave a larger increase in yield than either single dose at 6 of the 11 centres where this comparison was made. The increase was statistically significant at 2 of these 6 centres and only just failed to reach significance at 2 other centres. Since the single dose of nitrogen varied from 500 to 600 lb. of sulphate of ammonia per acre, this response to the double dressing, though confined to few centres, lends support to the view that, in some circumstances, liberal use of nitrogenous manures is of great benefit to the Brussels sprout crop.

It will be observed from Table II, however, that there was very little response to nitrogen at several centres, especially where dung was applied. Hence the nitrogen requirements of this crop, under different circumstances, must vary between wide limits and its nitrogenous manuring should therefore receive careful consideration if it is to be adequate without being wasteful.

Influence of Fertilizer on Production of "Blowers." When a treatment brings about a large increase in the yield of saleable sprouts it may simultaneously increase the weight of "blowers." This cannot be regarded as a serious matter, however, if the *proportion* of blowers is not increased.

Table IV shows the influence of various nitrogenous treatments on the *proportion* of blowers at 8 centres, i.e., the weight of blowers expressed as a percentage of the sum of the weights of firm sprouts and blowers. At the other 6 centres the weight of blowers was negligible.

TABLE IV

WEIGHT OF "BLOWERS" AS PERCENTAGE OF "FIRM SPROUTS + BLOWERS"

Season Centre	1934–35				1935–36	1936–37		
	B.	C.	H.	W S	B.	B.	H.	W S.
No Nitrogen ..	10·03	2·07	12·1	14·8	9·25	2·52	7·34	5·37
Soot alone	9·35	1·86	10·4	16·2	10·60	3·15	8·01	6·23
S/Ammonia alone..	9·53	1·03	9·7	13·9	9·10	3·17	7·88	5·74
Soot + S/Ammonia together	11·63	0·96	—	17·2	10·87	3·64	8 65	5·95
Standard Error ..	*1·53*	*0·32*	—	*5·2*	*1·07*	*0·20*	*0·33*	*1·66*

Table IV shows that, in these experiments, the effect of nitrogenous fertilizer on percentage of "blowers" was relatively small. It is not surprising, therefore, to find that the difference between the effects of sulphate of ammonia alone and soot alone was never large enough to be significant.

Cumulative Effects. These experiments were not intended to test any points other than the effects of soot and sulphate of ammonia on the growth and yield of the crop to which they were applied. The determination of cumulative or residual effects, and effects on such things as soil tilth and incidence of pests and diseases, requires more elaborate technique.

Soot may have advantages, especially on old market-garden land, if it has any insecticidal or fungicidal effects. Further, it is often claimed that soot improves the tilth of heavy soils. It is suggested, however, that the Brussels sprout crop is now frequently grown on light and medium soils, farmed largely on a rotation of ordinary farm crops, where nitrogenous fertilizers are required solely as sources of nitrogen. These experiments provide no evidence to suggest that, in such circumstances, soot should be valued on any other basis than its content of nitrogen.

EXPERIMENTS AT THE NORFOLK AGRICULTURAL STATION

In each of the four years 1933-36, experiments on somewhat similar lines to those described above were made independently at the Norfolk Agricultural Station, Sprowston. Mr. F. Rayns, the Director of that Station, has agreed to the inclusion of a summary of the results in this account of the Provincial trials.

In the Sprowston trials an application of 1 ton of soot per acre was compared each year with applications of 2 and 4 cwt. per acre of sulphate of ammonia. No record of the nitrogen content of the soot is available, but the two sulphate of ammonia treatments supplied nitrogen equal to that in 1 ton of soot containing 2.06 per cent. and 4.12 per cent. nitrogen respectively. It is not likely, therefore, that the soot used supplied less nitrogen than the smallest dressing of sulphate of ammonia.

These trials were on light loam soil and replaced part of the "seeds" shift in a five-course rotation of farm crops. All plots received dung, at 9-12 loads per acre, and a basal

dressing of 4 cwt. per acre superphosphate and 4 cwt. per acre sulphate of potash. In 1933, each treatment was replicated 4 times in a 4 × 4 latin square, but in 1934, 1935 and 1936 each treatment was replicated 6 times in a randomized block layout. Plants were raised in a seedbed and planted out 3 ft. × 3 ft. In 1933, the variety used was strain 31/59 from the Cambridge Horticultural Research Station. In 1934, 1935 and 1936 the variety Rous Lench was used.

The yield of saleable sprouts and the percentage of blowers in each season are shown in Tables V and VI.

TABLE V—YIELD OF SALEABLE SPROUTS
(cwt per acre)

Season	Yield without Nitrogen	Increase in Yield due to —			*Standard Error*
		Soot @ 1 ton p a	S/Ammonia @ 2 cwt p a	S/Ammonia @ 4 cwt p a	
1933	60·5	0·5	+ 3 3	+ 4·0	*1 21*
1934	95·2	+ 4·7	0 0	+ 11 2	*2 66*
1935	48·3	+ 10·3	+ 6·3	+ 3 4	*2 38*
1936	80·1	+ 13·2	+ 6·6	+ 21 5	*3 47*
Mean	**71·02**	+ **6·92**	+ **4 05**	+ **10 02**	—

TABLE VI—YIELD OF BLOWERS AS PER CENT OF TOTAL PRODUCE

Season	Nitrogenous Fertilizer				*Standard Error*
	None	Soot	2 cwt S/A	4 cwt S/A	
1933	17·85	19·78	16·72	15·99	*1 26*
1934	6 72	7 99	8·56	5·62	*0·99*
1935	22·81	21 85	21·60	25·10	*1·59*
1936	8·45	13·07	7·87	13 24	*1·22*

On the average of the four seasons, the yield increase from soot was intermediate between those from the two levels of sulphate of ammonia. Hence, though it is not possible to make a comparison on a strict quantity of nitrogen basis, it is obvious that soot was no better than a moderate dressing of sulphate of ammonia. In all seasons the effects of soot and sulphate of ammonia were most pronounced in the early part of the picking season.

Neither soot nor sulphate of ammonia had any significant effect on yield of " blowers " except in 1936, when soot and 4 cwt. sulphate of ammonia each significantly increased the

weight and percentage of " blowers." In 1933 soot produced large plants but the " buttons " were smaller and not quite so firm as those from 4 cwt. sulphate of ammonia. In the other seasons it was not possible to distinguish between produce from plants receiving soot and those receiving sulphate of ammonia.

The results of the Sprowston trials, therefore, are in close agreement with those of the Provincial trials.

Summary. 1. Experiments are described in which soot and sulphate of ammonia are compared as sources of nitrogen for the Brussels sprouts crop.

2. When used in quantities supplying equal amounts of nitrogen, their effects on yield of saleable sprouts were very similar and only differed significantly on two occasions.

3. Increases in yield from either source of nitrogen were most marked at the early pickings.

4. The produce showed no difference, either as regards colour or firmness, between sprouts from plants receiving sulphate of ammonia and others receiving soot.

5. Soot and sulphate of ammonia did not differ significantly in their effect on the *proportion* of " blowers " produced.

6. No attempt was made to compare cumulative effects on soil tilth or pests in the soil. With this proviso, however, soot and sulphate of ammonia proved equally effective as sources of nitrogen, under the conditions of these experiments. No evidence was obtained to suggest that, from the standpoint of its direct effect on the Brussels sprouts crop, soot should be valued on any other basis than its content of nitrogen.

GRASS DRYING: A PRELIMINARY SURVEY AND DISCUSSION

INTRODUCTION

W. F. Darke, B.Sc., Ph.D., B.Litt.

Over a century ago English farmers were debating the merits of mechanical threshing machines. Some Lothian farmers had installed steam engines costing £120, and worked threshers costing £90 apiece. They were the pioneers mocked by the gangs travelling round the Wiltshire Downs with hand-driven threshing machines and by the farmers who still clung to flails. In modern times there are few spectacular innovations in English farming, for the combined harvester has been well tried overseas, and, as a general rule, the more recent examples of ingenuity in farming methods have been applied successfully only to limited local conditions. Historians of the next century may have to record grass-drying technique as one of the main developments of our era, or they may have to regard it as a freak development of short duration. It is without doubt, however, that grass drying is the most recent innovation to our farming practices and is still under judgment.

After several years of laboratory research, grass-drying machines were first ready for practical tests under field conditions in 1933, but it was not until 1935 that the general farming public became really interested and attended demonstrations in large numbers. A great controversy on the merits of dried grass then started. Some of the pioneers are still enthusiastic; some are greatly disappointed and have given up the process; a few more farmers have decided to try it for themselves, but the bulk of them prefer to see the results of further experience before they commit themselves.

What was claimed for grass drying? It was an attempt to save some of the losses in food value in grass when being made into hay and also when bad weather prevented the hay from being lifted immediately. The dried grass was claimed to be a highly concentrated food, rich in protein and carotene, which would help to displace some of the big bulk of imported concentrates, on which the dairy industry is partly dependent. It was rightly asserted that there was an enormous wastage in the traditional methods of hay-making, and that a good proportion of grass land was always surplus at flush seasons

and almost sure to be lost. If grass could be dried artificially, therefore, the land could be cut several times during the season despite wet weather, and every field could contribute its full share to the farm. It was a kind of factory process applied to agriculture. Frequent rotational cuts of grass would reduce the overhead costs of the machinery required and would supply the bulk of the winter feed at a low cost. Not only was the farmer to obtain bulk, but he was to obtain a superior feeding product from the higher protein of the young leafy grass and its rich carotene content, which is mainly lost by the hay-maker. Thus, instead of having a food supply of hay, straw and roots, requiring to be supplemented and balanced by concentrates, the cowman would have a balanced home-produced food at a cheap cost.

Farmers now have had three seasons in which to gain experience. Although the weather condition has been mainly perverse it is fairly obvious from all the known data that a ton of dried grass costs more than was anticipated, and on costs a process usually stands or falls. Two or three efficient farmers with the right kind of machine may be able to get their costs below £5 a ton, excluding management, farm overheads, interest and storage charges, but the general average appears to be nearer £6 a ton. Undoubtedly, a big obstacle to overcome is the allowance for depreciation, and this is why the drying of other crops is being attempted and cannot be ignored. The machinery and equipment is costly and necessitates a big through-put of grass or other crops if a low cost per ton is desired. It has been demonstrated quite clearly in farm practice, however, that the ordinary farm cannot be regarded as a summer factory for the production of grass. The normal routine must continue. If drought stunts certain grazing-lands, then stock must have access to fields originally assigned to grass-drying. The haysel neatly absorbs labour between spring cultivations and the harvest: any demands for extra hands at other seasons constitutes a real drain to farmers in these years of labour scarcity. Thus, instead of being a factory process, grass-drying has been forced to take its place in the normal run of the farm, and overhead costs have consequently been higher than anticipated. Strides in enginering technique have enabled more efficient machines to be constructed at a lower capital cost and these reductions in outlay may be even more in the future. This is only to be expected from an infant industry. Farmers, too, by an

efficient organization of their field labour and drying methods have done much to reduce direct costs. It is evident, however, that they still have the weather to face. A grass-drier may save a crop in wet weather, but during a drought it cannot make the grass grow and therefore stands idle.

The other side of grass-drying must not be forgotten. Most of the talk about costs loses sight of the fact that the product is not hay and its cost should not be compared rigidly with hay-making costs. Although the protein and carotene contents do vary under field conditions, dried grass has a richer feeding value than hay. On the other hand, it is not a highly concentrated food which can displace the bulk of imported feeding stuffs. Undoubtedly much has to be studied regarding the nutritive value of dried grass before its true worth can be assessed, for besides being a moderately rich protein concentrate, it is also a green food containing carotene and vitamins. In farming circles there is still much discussion as to what its exact place is in feeding rations. Most of the farmers with dried grass, however, appear to be well satisfied with the results and are prepared to continue. In some instances dairy farmers regard the drier as a kind of insurance policy. In dry weather they lose, but in a continuous wet hay time they are at least ensured of a supply of bulky food which is better than hay to carry them through the winter. Thus, they have a sense of security, for much pasture land cannot be grazed by cows in winter without causing damage, and green food such as kale cannot always be depended on during the latter half of the winter.

These pioneers, then, are doing good work for agriculture as a whole. Many are losing money which they are by no means sure of regaining. Farmers will follow all developments and results with interest, for grass is the basis of their industry. Grazing will always be the most economical way of using grass, but any cheap means of preserving a surplus for winter months must surely be a true economy by saving waste and cutting costs.

The two short articles which follow are written by practical farmers who have tried the process. It must be remembered that these two gentlemen have not identical farms or businesses and that their articles are not written in antithesis. Their contributions are not an attempt to deal exhaustively with the whole subject of dried grass, but are the opinions of two pioneers in the light of their own practical experience.

GRASS DRYING IN HERTFORDSHIRE

Mr. Russell Wood

Early in 1937 I decided to take the plunge and go in for drying grass with a Curtis Hatherop machine. The orders were placed at the end of January and beginning of February, but owing to the difficulty in getting materials at that time, there was considerable delay in delivery, with the result that we did not start drying until May 14, although there had been grass for about a fortnight. The effect of this was that the grass beat us and beat us badly. To cap our troubles the machine did not, at the start, function as it should have done and as it is doing this year. We could not get anything like the output we do now without any difficulty; the most we were able to get was about 1-1½ cwt of dried grass per hour, but by the end of the season our average production was 313 lb.

We gained a lot of experience, much of which we paid for. At the finish we had 99 tons of grass, which, according to costings done by the Hertfordshire Institute of Agriculture, had cost us £6 1*s*. 3*d*. per ton Owing to the late start and our inexperience, the quality of the product was not nearly as good as we had hoped it would be, and we could not use it to displace as much cake as we expected. We started feeding it at the rate of 9-10 lb per day to dairy cows to displace 6 lb. of compound cake, but found that it was of such a quality that it would not displace more than the first 4 lb. The average protein content was only about 13 per cent. in terms of dry matter. All this was valuable knowledge, and during the winter of 1937-38 we installed a semi-producer furnace instead of the direct furnace, and increased the draught to the safety limit. These alterations have resulted in a reduction in the amount of coke used from over 15 cwt. to between 11 and 12 cwt. per ton of dried grass; and our output is now very seldom below 4 cwt. per hour, and ranges up to 8 cwt. on dry days when working on semi-wilted material.

This year we started drying on April 29. It is fresh in everyone's memory that up to the beginning of August the weather of 1938 has been exceptionally dry, especially in the eastern counties, and the yields off the permanent pasture have been low. This is going to add very considerably to the cost of the finished article, because of the extra cost of cutting and the charge for rent. To take an extreme example: If your rent is

£1 per acre and you get 2 tons of dried grass per acre, the charge for rent will be 10s. per ton, but if the yield is only 10 cwt. per acre the charge will be £2 per ton. This applies to hay and other crops, and I suppose would be considered an ordinary farming risk.

From April 29 to July 5 we dried 125 tons, which included about 22 tons of super hay. On July 5 we had to shut down for want of grass until July 18; then we started again and ran until August 8, by which time we had a total of 160 tons. The hours worked had to vary with the quantity of grass coming in, but on the whole we tried to keep the machine running from 6.30 A.M. until 7 P.M., without stopping for meals. When the grass looked like beating us we had to go longer and when we were beating the grass we worked shorter hours.

The results from the various cuts are given below. The protein contents have been determined by the School of Agriculture, Cambridge, and are given in terms of Dry Matter. The dried grass contains about 7 per cent. moisture.

Date	Field	Crop	Acreage Cut	Yield			Protein
				Tons	cwt	lb	%
April 29–May 6	A	Permanent grass	34	7	1	81	14·88
,, 7–9	B	One-year mixture	8	4	18	51	17·13
,, 10–11	C	,, ,,	7	3	7	35	19·28
,, 12	D	Permanent grass	16	2	12	73	14·15
,, 13–25	E	One-year mixture	14	18	14	38	15·04
,, 25–30	F	,, ,,	9	9	3	30	13·96
,, 31 to June 9	— A	Permanent grass	52	21	9	20	14·81
June 10–13	B	One-year mixture	8	5	14	19	20·37
,, 14–15	C	,, ,,	7	5	18	28	18·69
,, 16–18	D	Permanent grass	16	5	6	31	11·83
,, 20–24	—	Haymaking off about 42 acres		22	18	95	11·25 10·36
,, 25–30	E	One-year mixture	14	12	10	91	15·23
July 1–5	F	,, ,,	9	6	3	39	16·47
,, 18–19	B	,, ,,	8	2	8	20	19·54
,, 20	C	,, ,,	7	2	14	58	19·42
,, 21		Standing green crop bought		2	14	62	not sampled
,, 22–31	A	Permanent grass	52	15	4	16	18·34
Aug. 1–4	E	One-year mixture	14	6	19	110	16·66
,, 5–8	F	,, ,,	9	4	2	29	18·53

It is impossible to arrive at any definite figure for the costs of this year's working until we have finished, but it appears as though the charge for rent and cutting will be abnormally high and that, owing to the dryness of the atmosphere and the material, the actual drying costs will be lower than they

would be in a normal season. Taking all this into consideration, we should be well below the £5 per ton mark.

With a fair proportion of good quality feeding-stuff, the prospects for next winter look more hopeful, especially as the stockmen have learnt to appreciate the difference between hay, super-hay and dried grass. The thunderstorms of the beginning of August have given us hope that we shall yet have a good final cut in the autumn. The same storms have made the harvesting of oats a difficult job and we have been drying some in the sheaf on the drying machine. The results of this experiment are mixed. Whilst we are definitely saving our oats, it is a slow process, although it is possible to start first thing in the morning long before oats are normally fit to cart. I am very doubtful if the oats would germinate after being subjected to such heat. They seem very palatable. It is an expensive way of harvesting, but I believe better than sitting still and watching the oats grow in the stook.

GRASS DRYING: A WARWICKSHIRE EXPERIENCE

Mr. Clyde Higgs

I have viewed the prospect of grass-drying through rose-coloured spectacles; I have practised it in the cold light of hard facts; and now, looking back on my experiences from a distance, I am comforted by the tag that "the man who never made a mistake never made anything."

The title of this article is *Grass Drying*, and it is well to define at the start what I understand by that term. "Grass" in this connexion means something not more than 6 in. long, and "drying" means the extraction by artificial means of sufficient moisture, say, up to 80 per cent., to enable the residue to be conserved for use as concentrated foods. I am not concerned with the drying of hay, nor with any process not applicable to ordinary commercial farming.

I exclude aerodromes, where, in addition to paying no rent, the contractor is actually paid to cut the grass, and may be financially successful by a small margin in some instances. Also, I exclude the use of crops grown specially for factory drying. This, too, may be profitable, though it has not yet been proved. It is necessary to mention these exclusions, as in discussions on the failure of grass drying, supporters of the process are apt to fog the issue by drawing the herring of other crops and different conditions across the trail of farm grass drying.

It will be agreed generally that the easiest and consequently least profitable of any system of farming in most parts of this country is that of permanent grass. As a dairy farmer, I fell under the spell and burdened myself with the enormous cake bills which go with it. I became one of the great army of men who receive a milk cheque with one hand and pay it over to the cake merchant with the other. Then came the new gospel, " Store your own surplus production and use it instead of cake." Never did seed fall on more fertile ground than the message which now reached the ears of the dairy farmer, " Snap your fingers at the weather, and cock snooks at the cake merchants."

From here, it was but a short step to having a small experimental drier erected in 1934. It was not used in that year, as there was no grass whatever in the autumn, but it worked through the 1935 season, drying 100 tons, and gave promise of satisfactory commercial results on a larger scale. Accordingly, I installed two driers for the following year's crop.

It is impossible and unnecessary to relate here the trials and tribulations of a farmer who already has a full-time job, of running two grass driers for nearly six months, and for the greater portion of the time, day and night. No doubt the difficulties can be imagined, though it is interesting to note that no one who has published costs of dried grass has ever included any charge for management. The net result of my 1936 campaign was, roughly, 600 tons of material, varying from·8 to 19 per cent. crude protein, and my cake bills going on much the same as before. The approximate cost of the dried grass was £5 16*s*. 0*d*. per ton, against an average on five farms of £5 18*s*. 6*d*. These costs, based on theoretical figures for depreciation, are extracted from *Grass Drying in* 1936, issued by the Agricultural Economics Research Institute. Similar figures from the same source for 1937 are £6 2*s*. 9*d*., and the average of twelve farms was given at the Oxford Farming Conference of 1937 as £5 17*s*. 7*d*.

In passing, it is significant to observe that, in 1936, 894 tons were dried on five farms, but in 1937 it took nine farms to dry 707 tons. This is either a sign of waning interest or it shows that the weather restricted the supply of grass. What is the use of installing expensive machinery to make the farmer independent of the weather, if he continues to depend on the weather for his material?

In 1937, I made another attempt with a different make of

machine, and the results were even less satisfactory. In fact, by the beginning of June, I was forced to the conclusion that the only thing to do with grass drying was to abandon it.

To return to costs, it appears that a fair average price is £6 0*s*. 0*d*. per ton, but it must be noted that this excludes such important items as interest on capital, manurial residues of cake fed on the land, general farm overhead expenses, management and storage costs. The latter alone will add 3*s*. a ton in interest each six months.

Taking everything into consideration, the cost is very similar to that of dairy cake, which usually has a protein analysis of 22 per cent. Very little dried grass has a protein content which anywhere near approaches this figure. The average of 46 samples in 1936, and of 43 in 1937, is approximately 13.5 per cent. Too much reliance cannot be placed on these analyses. The majority of samples are taken in the flush of spring enthusiasm, giving a false value to the hay-like product of midsummer, and, in any case, I have known samples from the same field to vary by 25 per cent. in a few days. But even taking the figures at their face value, dairy cake wins hands down.

But is there anything else besides protein? Dried grass contains carotene. The main effect of this is to add colour to milk, but identical results can be obtained much more cheaply by feeding carrots, kale or silage, or even by adding 10 per cent. of Channel Island cows to the herd. In any case, colour is only of benefit to the producer-retailer; in the wholesale market, milk is milk. Secondly, dried grass has possibly a higher vitamin and mineral content than dairy cake. This again can be equalled by silage or kale.

Ton for ton, then, dairy cake, at about the same price, is far superior to dried grass as far as the main ingredients go, and if it contains less of the minor, but doubtless important, accessories, these can be easily and cheaply made good, as, for example, by means of a little fresh green food.

Hay, kale and concentrates are all things with which a farmer is familiar and which are readily available. Dried grass, on the other hand, involves him in a programme of rationing which, owing to the variable nature of the material, is difficult to organize, and which can only be embarked upon at all by putting down a great deal of capital.

No matter what type of drier you buy—and to-day, there are very few to choose from—the total installation for a

machine to give an output of 2½ cwt. of dried grass an hour will be not much less than £700. There is an impression abroad that a grass drier should be looked on as part of the general farm routine, and used to dry only a small acreage. Heaven forbid that we should exacerbate our financial troubles by buying further expensive machinery, which, when it is wet, will only do half its rated output, and, when it is fine, has nothing at all to do. In either case we should still have our hay-making with us.

There is yet another difficulty, for it is not possible to feed a cow for, say, five gallons a day, on dried grass alone, any more than it is on the fresh crop. Good grass will produce up to three gallons of milk daily, and if cake is necessary for the other two, it is far simpler to feed cake for the lot.

I know of National Defence, and how splendid it would be, on paper, for us to grow our own cow food, but it should be remembered that what we now use is only offal from materials which must be imported, war or no war.

Even in this admittedly most difficult year, hay is obtainable at round £5 a ton. There is abundance of good straw, and green crops, such as kale, have done remarkably well. What justification can there be for making dried grass every year as an insurance against the conditions this year which after all will most likely only happen once in a lifetime.

No, I do not think the salvation of British agriculture rests on grass, much less on grass drying.

GAS-STORAGE OF APPLES: PRECAUTIONARY MEASURES

FRANKLIN KIDD, M.A., D.Sc.,
Low Temperature Research Station, Cambridge,
AND
CYRIL WEST, M.A., D.Sc.,
Ditton Laboratory, East Malling, Kent

Home-grown apples are likely to be scarce this season, and it is therefore more necessary than usual that the best storage conditions shall be available and all reasonable precautions taken for that part of the apple crop which is to be stored, not only because the fruit is of greater value owing to its scarcity, but also because it is now generally agreed that fruit from a light crop is of poor keeping quality. The moment is opportune, therefore, for repeating and emphasizing the warning given on several previous occasions[5, 8, 9, 16]* as to the necessity of taking certain precautions when gas-storage of home-grown apples is being practised. Only certain precautions which, as experience has shown, are especially liable to be overlooked, are considered in this article. A general account of gas-storage will be found in Leaflet No. 6 of the Food Investigation Board. Where gas-storage of apples has not been completely successful, the lack of success can nearly always be traced to failure to fulfil one or more of the conditions dealt with in the following paragraphs.

Use of the Correct Temperature and Atmosphere. So far, growers have been concerned mainly with the storage of only one variety—the Bramley's Seedling. The optimum atmospheric conditions for this and for a few other varieties of apples can be obtained by the simple method of restricted and controlled ventilation, which can be secured by allowing the respiratory activity of the fruit to bring about the required atmospheric conditions in the store. The gases to be controlled are oxygen and carbon dioxide, and the latter is produced from the former, volume for volume, by the respiratory activity of the fruit.† The concentration of carbon dioxide

* For references see p. 699

† Several instances have been brought to our notice where the temperature of the fruit has intentionally been allowed to remain at a high level in order to speed up the accumulation of carbon dioxide in the storage atmosphere This procedure is strongly to be deprecated If the gas-store is reasonably gas-tight, the correct concentration of carbon dioxide will be reached sufficiently quickly even when the temperature of the fruit is brought down to the proper level as quickly as possible.

is controlled by regulated ventilation with fresh air, the excess of carbon dioxide being replaced, as required, by oxygen in the air. Since the sum of the concentrations of oxygen and carbon dioxide must equal 21 per cent. (i.e., the concentration

TABLE I

TEMPERATURES AND ATMOSPHERES RECOMMENDED FOR THE STORAGE OF HOME-GROWN APPLES

VARIETIES REQUIRING CONTROL OF TEMPERATURE AND OF CO_2 ONLY				
Varieties	Type	Temperature	CO_2	Oxygen
		(°F)	(%)	(%)
Bramley's Seedling	Culinary	40	8–10	13–11
Lord Derby	,,	40	8–10	13–11
Stirling Castle	,,	40	8–10	13–11
VARIETIES WHICH REQUIRE INDEPENDENT CONTROL OF BOTH CARBON DIOXIDE AND OXGYEN, IN ADDITION TO TEMPERATURE CONTROL				
Varieties	Type	Temperature	CO_2	Oxygen
		(°F)	(%)	(%)
Lane's Prince Albert	Culinary	39–40	5	2·5–5
King Edward VII	,,	37–40	5–10	2·5
Monarch	,,	34	5	2·5–5
Ellison's Orange	Dessert	34	5	2·5–5
Cox's Orange Pippin	,,	39–40	5	2·5
Laxton's Superb	,,	40	10	2·5
Worcester Pearmain	,,	34–35	5	2·5–5
Allington Pippin	,,	37	3	2·5
VARIETIES REQUIRING CONTROL OF TEMPERATURE WITH VENTILATION TO REMOVE CARBON DIOXIDE.				
Varieties	Type	Temperature	CO_2	Oxygen
		(°F)	(%)	(%)
Annie Elizabeth	Culinary	34–35	0	21
Newton Wonder	,,	34	0	21
Blenheim Orange	Dessert	37–38	0	21
King Pippin	,,	39–40	0	21

NOTE.—It is quite easy to damage apples by too high a concentration of carbon dioxide or by too low a concentration of oxygen. The limits of tolerance vary with the variety and with temperature.

of oxygen in air), it is necessary to record only the percentage of carbon dioxide present and to control the atmospheric composition by this factor. It is obvious that with this method of operating the store, separate control of the oxygen and carbon dioxide is not possible.

Most of the existing gas-stores have been designed primarily for the storage of Bramley's Seedling apples, but many varieties, including the important dessert apples, Cox's Orange Pippin, Laxton's Superb, Worcester Pearmain and Ellison's Orange, require an atmosphere in which the concentration of both oxygen and carbon dioxide is low (Table I). Such atmospheres cannot be obtained simply by regulating the ventilation; independent control of the oxygen and of the carbon dioxide is essential. The respiratory activity of the fruit is utilized to reduce the concentration of oxygen from the normal 21 per cent. in air to the required lower level, with the production of an approximately equivalent amount of carbon dioxide, which is, in turn, reduced to the correct level by removing the excess by means of a chemical absorbent, such as caustic soda or milk of lime. Chemical absorption of this excess of carbon dioxide can be controlled by regulated circulation of the atmosphere of the storage chamber through a scrubbing device containing the appropriate absorbent.

This method has now been thoroughly tried out in the laboratory and also under commercial conditions, and has proved to be simple to operate and entirely satisfactory from the point of view of the fruit. Standard equipment, including suitable types of instruments for measuring both the oxygen and the carbon dioxide is now available. Hence there is no longer any need to store any variety of apple in a chamber that is not suitably equipped for that particular variety.

In this connexion it is interesting to refer to a comparison that was made on the occasion of the large-scale demonstration of refrigerated gas-storage of Cox's Orange Pippin apples at the Ditton Laboratory on February 22, 1938. The comparison was made between Cox's Orange Pippin apples stored in an atmosphere of 5 per cent. carbon dioxide + 16 per cent. oxygen + 79 per cent. nitrogen (obtained by the method of controlled ventilation) and similar fruit stored in 5 per cent. carbon dioxide + 2.5 per cent. oxygen + 92.5 per cent. nitrogen, the atmospheric conditions recommended for this variety on the basis of exhaustive storage trials. The results were most striking (Table II) and showed that an overwhelming

advantage was obtained by the use of the correct storage conditions.

TABLE II

Gas-storage Conditions			Total Wastage after 5 month's Storage	Condition of the Fruit after 5 months' Storage
Temp	Atmosphere			
°F.	O_2 %	CO_2 %	%	
39	2 5	5	10	The fruit was firm, unripe, greenish yellow and in excellent marketable condition It ripened up satisfactorily in 14 days in air at room temperature.
39	16	5	46	The fruit was overripe, mealy and quite unfit to market The ground-colour was yellow

Importance of Stage of Maturity of Apples when Gathered. Success in gas-storage largely depends upon the fruit being gathered at the right stage of maturity. In a recent publication[11] the writers have dealt in some detail with this important practical problem and have endeavoured to make the position as clear as possible. It will suffice here to emphasize the importance of the " maturity " factor in the gas-storage of apples and to consider briefly the advantages and disadvantages of picking the fruit at various stages of maturity. As stated in the article referred to above, at about the time that growth in size of the apple tends to come to a standstill the fruit undergoes a vital change which the writers have termed the *climacteric.* A convenient index of the physiological and chemical changes going on in the fruit is provided by the rate at which the fruit gives off carbon dioxide, that is, by the rate at which it breathes. Fig. 1 shows a generalized curve for the respiratory activity of the apple during the period over which it is likely to be gathered. It will be seen that this period includes, in addition to the whole of the climacteric phase, part of the pre-climacteric and post-climacteric phases.

The reason why the stage of maturity of the fruit when stored is of such importance in the successful operation of the

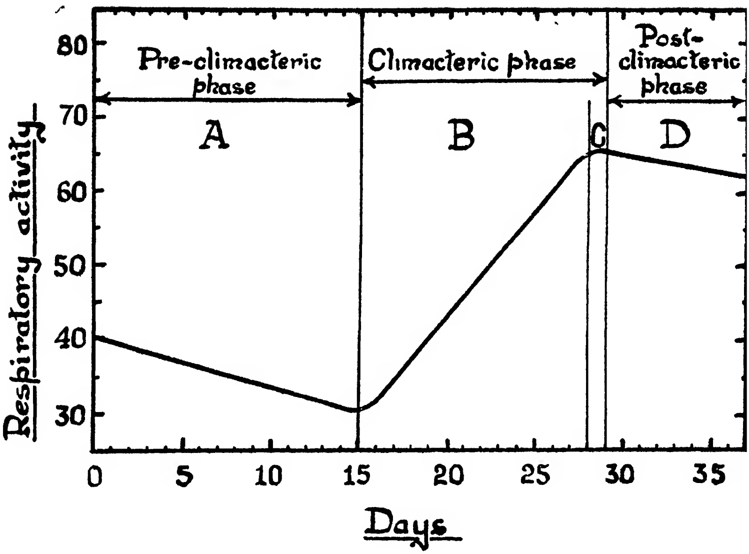


FIG 1.—Schematic Presentation of the Respiratory Activity (per unit fresh weight) of an Apple during the interval over which the fruit is usually gathered

gas-storage method is that the onset of the climacteric phase is suppressed or postponed in apples that are held from the time of gathering in an atmosphere containing a certain amount of carbon dioxide. In other words, the beneficial effect of the carbon dioxide in the storage atmosphere will be to a large extent lost if the fruit has reached its climacteric before it is stored. *Apples must therefore be subjected to the appropriate gas-storage conditions whilst they are still in the pre-climacteric stage.*

The effect of the maturity of the fruit when gathered on (1) its size and weight, (2) its susceptibility to wilting and loss of water in storage, (3) its quality, and (4) its susceptibility to superficial scald, may be summed up in the statement that the longer the fruit is allowed to remain on the tree the better. On the other hand, the more mature the fruit when placed in store the shorter will be its potential life and the more rapidly fungal wastage and the senescent type of breakdown will develop. In practice it is found that apples gathered over an interval of approximately two weeks, immediately prior to the onset of the climacteric phase, are at the most suitable stage for long period storage. Unfortunately, there is no

simple and trustworthy method of ascertaining when the apples have reached this particular stage of development. A fairly reliable index of this stage is when the fruit will part readily from the tree by gently twisting it on its stalk.

A grower with a large acreage of fruit might find it an impossible task to gather the whole crop within the period recommended. He would probably have to commence picking before the correct date and continue after it. In such circumstances, the fruit picked within this critical interval will be most suitable for gas-storage over a long period. As for the rest of the fruit, a sharp distinction should be made between that picked *before* and that picked *after* the two weeks interval. Although the former would probably not repay prolonged gas-storage owing to its liability to shrivel and scald, it could safely be gas-stored or even cold-stored for a relatively short period; the latter is not suitable for storage of any kind, and should therefore be marketed as soon as possible.

Effect of Delay between Gathering and Storing the Fruit. One of the most important problems the grower has to face is that of getting through the work of sorting and wrapping the fruit and of loading and sealing the storage chamber with the least possible delay.* The reason for this will at once be obvious from what has been said in the previous section. Delay in storing the fruit may allow it to reach the stage at which the main beneficial effect of gas-storage will be lost. The grower is therefore strongly advised to plan the various pre-storage operations in such a way that the interval between the gathering of the fruit and the sealing of the store is reduced to a minimum. *In most instances this interval should not exceed three days.*

Effects of Mixing Varieties in a Gas-store. In a season such as the present one, when the apple crop is very light, the temptation to store in the same chamber small quantities of several different varieties is likely to be even greater than usual. Those who yield to this temptation will be taking a risk which in the past has often not been fully appreciated.

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* Since the advantages of gas-storage are to a large extent lost if the apples are not subjected to the gas-storage conditions within a few days of gathering, it may be advisable, in order to avoid delay in loading the store, to postpone grading for size until after removal from store. Mechanical sizing of the fruit can safely be carried out after gas-storage, provided reasonable care be taken to avoid bruising.[15]

Even when varieties of apples require similar conditions both as regards temperature and atmospheric composition, this does not necessarily mean that such varieties can be stored together. Apart from the fact that the picking dates and possibly also the storage periods of such varieties may not coincide, the varieties may effect one another by means of the volatile substances they produce during ripening.

Since gas-storage is essentially a system of restricted ventilation, it follows that not only the carbon dioxide but also any other volatile substances produced by the fruit will tend to accumulate within the store. The question at once arises as to what effect, if any, the presence of these volatile substances has on the fruit. The main difficulty in answering this question lies in the fact that our knowledge regarding the number and nature of the volatiles produced by apples is still extremely inadequate, since there are no easy or direct methods of isolating and measuring them. Moreover, practically no information is available as to the rate at which they are produced, as to the effect of pre-storage and storage conditions on their production, and as to the limits within which different varieties of apples will tolerate them. So far only certain harmful effects of their accumulation are recognized. For example, the disease known as "scald," which is attributed to the accumulation at the surface of the fruit of an unknown volatile substance or group of substances, would have rendered gas-storage of apples quite impracticable unless suitable preventive measures had been available. Fortunately, the practical method, devised in the United States of America, of wrapping the apples in paper impregnated with odourless mineral oil, has generally been found to give complete control of this trouble. In this connexion it should be pointed out that if full control of scald is to be obtained it is essential that the quantity of oil contained in the wrappers should comply exactly with the specification laid down by the American workers.[3, 6] In the experience of the writers, the cause of considerable wastage of fruit has been traced to the use of wrappers which, when analysed for their content of oil, did not come up to this specification.*

An important advance in our knowledge was made when it was discovered that during their climacteric apples and

*The tissue paper should contain 15·20 per cent of oil (based on the original weight of the paper) A special light, odourless and tasteless mineral oil should be used.

certain other fruits produce small quantities of ethylene.[1,8] It was also shown that this gas stimulates the climacteric in apples. When, therefore, ripe apples are stored in the same gas chamber as unripe apples there is a great risk of losing the full advantage that would be gained by the presence of carbon dioxide in the atmosphere because the ethylene produced by the ripe fruit may stimulate the climacteric in the unripe fruit.[7,10,13]

Recent experiments, detailed results of which are presented elsewhere,[14] have fully confirmed the fact that ethylene stimulates the ripening of apples under gas-storage conditions. They have also shown conclusively the harmful effect that ripe (i.e., post-climacteric) Worcester Pearmain or James Grieve apples may have on certain late varieties such as Bramley's Seedling or Laxton's Superb, when they are stored together in the same chamber. The injury took the form of severe lenticel spotting, which, although definitely functional in origin, was often followed by fungal invasion of the injured tissues. The characteristic appearance of affected fruit is shown in Fig. 2. The marked difference between samples of the control fruit (i.e., that stored by itself) and the corresponding samples that had been exposed to the vapour from the ripe apples is clearly brought out in Fig. 3.

An Initial Effect of Carbon Dioxide on the Respiratory Activity of Apples: a New Fact of Practical Importance in Gas-storage. The records of the rate of accumulation of carbon dioxide in commercial gas-stores have on occasion shown a more rapid increase in the concentration of this gas during the first few days after closure than was expected on the basis of the data published hitherto,[4] which indicated that carbon dioxide reduces the respiratory activity of the apple fruit. Recent work in the laboratory has provided an explanation of such unexpectedly rapid rises. In brief, it has been found that apples in the pre-climacteric condition exhibit, on exposure to atmospheres containing up to 10 per cent. of carbon dioxide, a temporary increase in the rate at which they respire.[12] The practical bearing of this phenomenon on commercial gas-storage will at once be appreciated. The possibility of the concentration of carbon dioxide reaching dangerous levels is greater in the period immediately after the fruit has been put into store, especially if it is warm, and on that account respiring rapidly, than had hitherto been thought

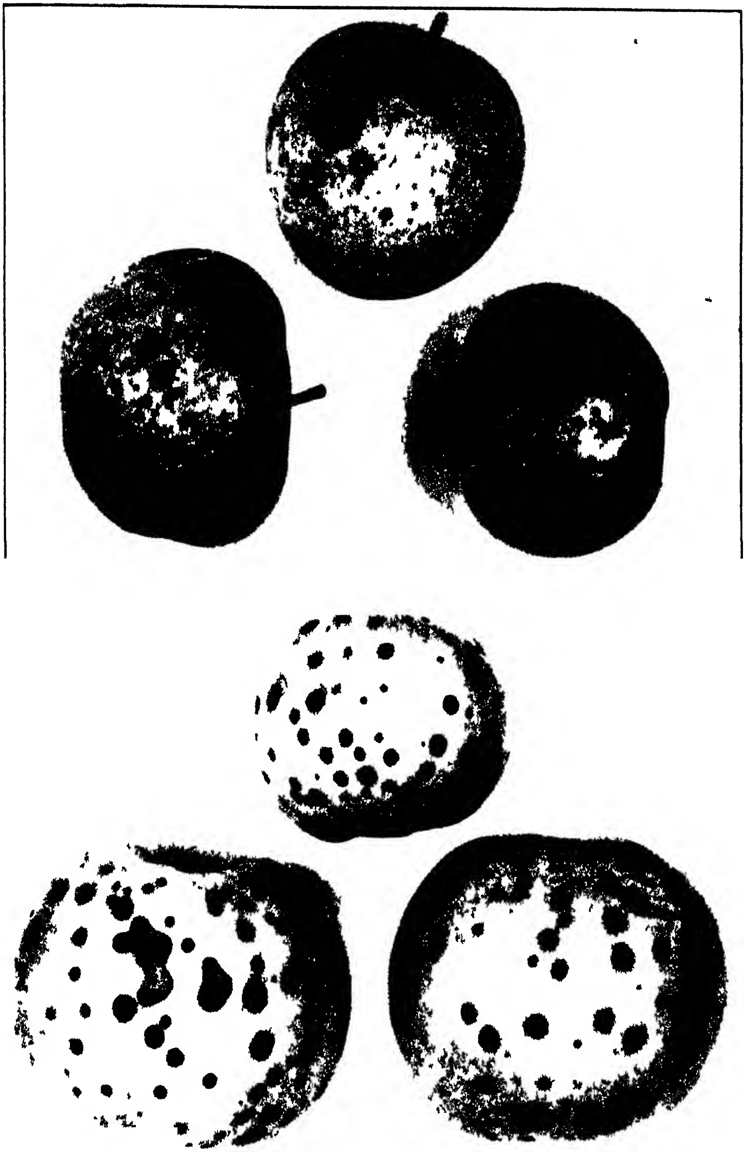

FIG. 2. *Top.* Lenticel spotting on Laxton's Superb Apples that had been stored with ripe James Grieve Apples. *Bottom.* Lenticel spotting on Bramley's Seedling Apples that had been stored with ripe Worcester Pearmain Apples.

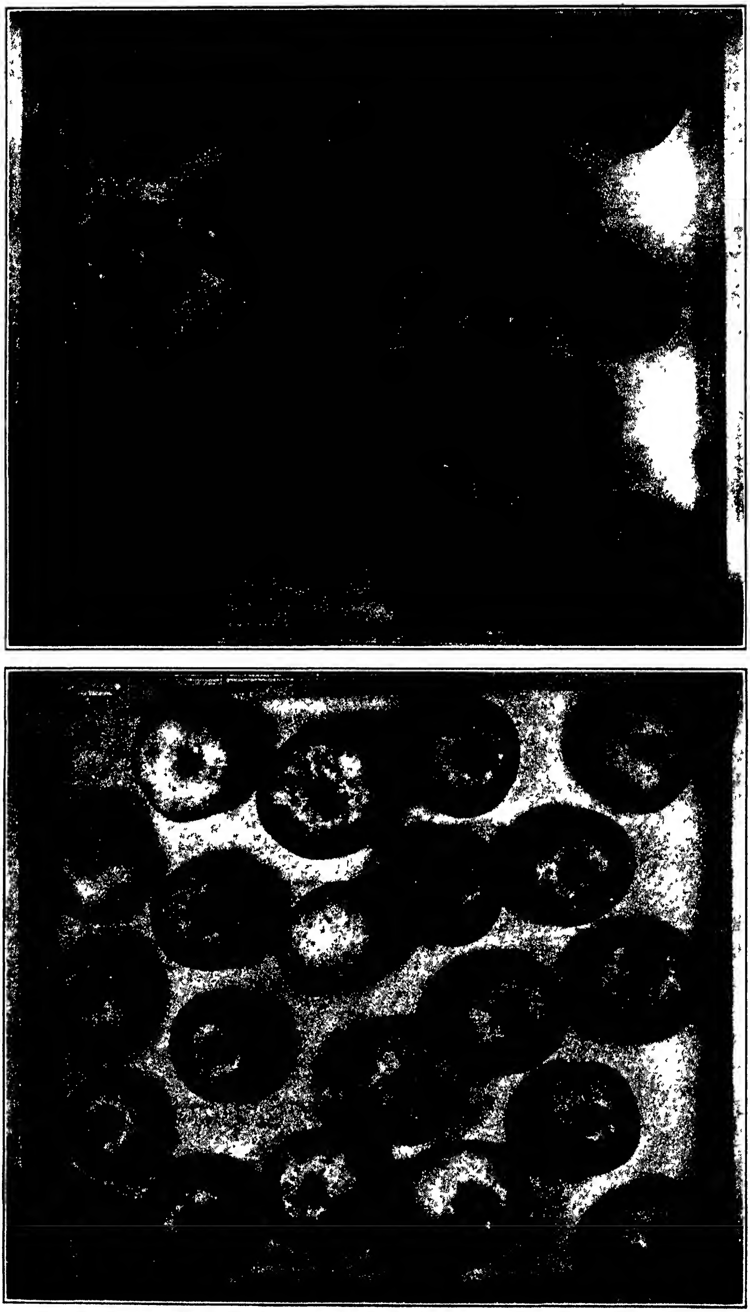

FIG 3 —Bramley's Seedling Apples after 5 months' gas-storage *Top* Control fruit,

possible. During this early period of storage the rate of accumulation of carbon dioxide should be carefully watched.

Conclusion. The best results in the gas-storage of any variety of apples can be obtained only by the use of equipment that will provide precisely those conditions which have been found, as the result of extensive storage trials, to be most suitable for that particular variety. Recommendations, based on the results of such storage trials, which are made from time to time, should be followed as closely as possible.

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MANURING

F. Hanley, M.A.,
School of Agriculture, Cambridge

How to Encourage Early Spring Grazing. When the deficiency of rainfall becomes as pronounced as it did in many parts of the country during the first six or seven months of this year, the dependence of farming on weather conditions becomes strikingly apparent on arable and stock farms alike. The rainfall on the Cambridge University Farm, for example, only amounted to 6.996 in. for the whole of the seven months from January 1 to July 31, and of that small total 2.50 in. fell during the month of January. One result of this long spell of droughty weather was a very serious restriction in the growth of grass on both hay and pasture lands. Many farmers had to feed full winter rations of concentrates to their stock for several weeks during the summer months, the pastures being bare of keep. Even if the rainfall since July revives the pastures during the autumn, as seems probable at the time of writing these notes, there is still likely to be a serious shortage of home-grown hay for winter keep, so that on many farms a heavy summer cake bill will be followed by difficult and costly winter feeding.

It is, of course, too late to do anything now to increase the amount of autumn and winter grazing. Early spring growth would, however, reduce the length of the winter feeding period, and though weather, especially temperature and rainfall during the spring months, determines whether the growth of young grass will be rapid or slow, it is often possible to accelerate the rate of spring growth by proper autumn management combined with judicious use of nitrogenous fertilizers.

There is no immediate hurry about the application of the nitrogenous fertilizer. The important thing to decide at this time is which field or fields are best suited to the production of early grazing. A nitrogenous dressing increases the rate of growth of grasses once growth has commenced, but the actual date of commencement depends primarily on soil temperature and the species of grass. G. E. Blackman found little active growth as long as the soil temperature remained below 42°F., irrespective of whether nitrogenous fertilizer had been applied.

Between 42° and 47° however, natural growth took place, though somewhat slowly. Where a dressing of nitrogenous fertilizer had been applied the rate of growth was greatly accelerated between these two temperatures. When the soil temperature is above 47° the effect of nitrogenous fertilizer becomes less marked again, and hence the extent of the effect of a nitrogenous dressing depends very largely on the length of time the soil temperatures remain between 42° and 47°F.

Since temperature is so important in the growth of spring grass it is essential to choose light, well-drained fields as far as possible, for heavy, wet land is notoriously " late " and no amount of fertilizer can make it " early." Sheltered fields, sloping to the south, are preferable. Herbage species vary considerably in their " earliness," and unless a sward contains a good proportion of early species, e.g., perennial rye grass, it is very little use trying to get an early bite from it.

Having decided which field or fields most nearly fulfil the above requirements, autumn management becomes important. Stock at present grazing the fields should be removed as soon as possible. It may be helpful to harrow the land straight away but no stock should be allowed on during the winter. There is sometimes a tendency to let stock have access to larger tracts of land in the autumn, even where grazing is carefully controlled during the summer. This may reduce the degree of " poaching " if the autumn happens to be wet, but at the same time it must be remembered that fields which are required to produce an early bite must be cleared of stock in the early autumn in order to give the grass a rest.

It should not be necessary to point out that there must be adequate amounts of phosphate and potash in the soil. Though the application of nitrogen is the main factor in producing an increased amount of early growth, it should be obvious that the plants also require adequate amounts of the other plant foods. Again, nitrogen will not work properly on a soil which is so acid as to inhibit growth or restrict the herbage to late species. Fields deficient in lime, phosphate or potash should not be chosen for " early bite " production if others are available. Even if such deficiencies are made good this winter, the sward will require some time to recover from their harmful effects before it can make full use of nitrogenous fertilizer.

Once growth has commenced in the spring, moisture and nitrogen supplies become important factors in the rate of growth. As already mentioned, the value of nitrogen is

probably greater when soil temperatures remain only just above the minimum required for growth, since at higher temperatures soil organisms become more active and liberate more nitrogen from soil reserves. The best time to apply the nitrogenous fertilizer will therefore depend on the date when growth is likely to commence and must be decided in the light of local conditions. In naturally late districts the end of February or early March is often soon enough, but in earlier districts the first half of February may be a more suitable time. For instance, experiments over five seasons, carried out by the Eastern Counties Provincial Conference, suggest that application of sulphate of ammonia during the first half of February can usually be relied on to produce an increase in the amount of grazing available in April in the eastern counties. In parts of the country where February is a very dry month, application in December is sometimes preferred, though comparison of December and February applications made in five of the experiments carried out by the Eastern Counties Provincial Conference, showed little difference between them. In each experiment the yield was measured by cutting the herbage during the second week in April.

YIELDS OF DRY MATTER (CWT PER ACRE)

Centre	*No Nitrogen*	*1 cwt S/Ammonia early December*	*1 cwt S/Ammonia early February*
C. 32	4·79	6·35	5·52
H. 32	1·15	2·69	2·07
C. 33	4·71	7·02	6·82
H. 33	3·63	4·31	4·98
E. 33	4·48	5·95	6 22
Mean	3·75	5·26	5·12

It will be seen that the amount of early bite varied considerably in the different experiments, and this of course happens in practice. Though one can reasonably anticipate some appreciable advantage on the average of a period of years, occasional years may show very little return from the nitrogenous dressing.

In the experiments referred to above, only 1 cwt. per acre of sulphate of ammonia was applied. In general it probably pays to give a rather heavier dressing of this or some other equally quick-acting nitrogenous fertilizer, even if this means treating a smaller area. Low rates of application may fail to give the required stimulus to growth. Several experiments have shown that dressings up to 3 cwt. per acre will give proportionate increases in yield.

Manuring of Autumn Sown Arable Crops. This is usually confined to such crops as winter beans, wheat, winter oats and winter barley. In addition, the apportionment of the available supplies of farmyard manure and the autumn application of the less soluble fertilizers, such as basic slag and ground mineral phosphate, have to be considered at this time.

Winter Beans. These are particularly responsive to farmyard manure and phosphates, but artificial nitrogenous fertilizers are not usually required. In the absence of farmyard manure, beans will often respond to potash, even on heavy land, provided the crop receives a good dressing of phosphate as well. Experiments on heavy Boulder Clay soils as far apart as Saxmundham in East Suffolk and Cockle Park in Northumberland showed the benefit of using about 1 cwt. per acre of muriate of potash in addition to phosphate when no farmyard manure could be given. Beans should receive phosphate even when farmyard manure is given. From 3 to 5 cwt. per acre of superphosphate is a suitable quantity, according to the amounts of phosphate applied to previous crops. Alternatively, basic slag at about 5 cwt. per acre is suitable on heavy soils for those who are fortunate enough to have any slag. It should be emphasized that slag should not be used for beans at the expense of heavy grass land in need of phosphate. In general, it will pay best to give the grass land preference over the bean crop in the matter of basic slag supplies and buy superphosphate for the beans if there is not sufficient slag for both.

Winter Cereals. Where these follow such crops as potatoes, sugar-beet, beans, peas, etc., the question of autumn manuring does not usually arise. Where wheat follows a crop of clover seed or, in some parts of the country, a one-year "seeds" layer (hayed) it will usually respond well to a dressing of farmyard manure. Wheat following another white straw crop should receive either farmyard manure or 3-4 cwt. of artificial fertilizer, except on rich soils such as the Fens and the land known to be in high condition. Superphosphate at 2-3 cwt. per acre should be worked into the seedbed together with ½-¾ cwt. per acre of sulphate of ammonia and, on very light soils, ½ cwt. per acre of muriate of potash. Such a mixture, including the potash, would have an analysis somewhat as follows:—nitrogen (N) 3-4 per cent., water-soluble phosphoric acid (P_2O_5) 10-12 per cent., and potash (K_2O) 5-6 per cent.

Oats or barley (whether for malting or feeding), when sown in the autumn after a crop that received farmyard manure or was fed off by stock, should require no autumn manuring. Where these crops follow another white straw crop, however, they should receive the dressings of artificials recommended above for wheat in similar circumstances. Those who prefer to use the so-called " concentrated complete fertilizers " will find that 1½-2 cwt. per acre of C.C.F. No. 6 will supply approximately the same amounts of nitrogen, phosphate and potash as the mixture set out above.

The small amounts of nitrogen included in the above recommendations for winter cereals are only intended to assist in the establishment of the crop where the soil is in a low state of fertility. The major nitrogen requirements of these crops must in all instances be met by further dressings of nitrogenous fertilizer in the spring.

The importance of having plenty of available phosphate in the soil for a winter-sown crop is often not fully appreciated. This is particularly true on heavy soils and soils in a low state of fertility. Sometimes an application of phosphate is deferred until the spring on the grounds that it can then be applied with the usual spring top dressing of nitrogen, thereby reducing the cost of distribution and eliminating the risk of the phosphate being washed out of the soil during the winter. Such a practice is definitely wrong on land in need of phosphate, for the risk of rain washing out the phosphate is negligible, and, if the crop is to winter well and grow away when weather conditions become favourable in the spring, it must have plenty of phosphate to establish a well-rooted, full plant in the autumn. If phosphate is to be applied at all to an autumn-sown crop, whether cereal or beans, it should be applied in the *autumn* no matter what form of phosphate is used.

COMPUTATION OF THE COST OF FOODS FOR LIVE STOCK

H. T. MATTHEWS, B.V.Sc., F.R.C.V.S.,

AND

R A. MORTON, D.Sc., Ph.D., F.I.C.

The practical problem of purchasing rations for live stock on an economical basis has led the writers of this article to make the following contribution to the discussion of the subject. The article falls into two divisions: in the first place a nomogram has been constructed to avoid the repetition of small calculations needed to ascertain costs or values per lb. of starch equivalent for foods of varying prices and composition; and in the second place an attempt has been made to refine the method of assessing the value of high protein feeding stuffs by taking into account their concentrating effect and the special qualities of some proteins.

The basis of the discussion is the table of "Prices of Feeding Stuffs" accompanied by the "Starch Equivalents" and "Protein Equivalents" published monthly in this JOURNAL (see p 744 of the present issue). These "equivalents" are widely accepted as a basis for assessing the relative nutritive values of feeding stuffs of various kinds. The figures apply to typical samples of these commodities and any correction for the quality of a particular sample is perforce left to individual judgment. The utility of the Table as a guide to real costs in terms of food units is increased by including manurial values and prices per unit (22.4 lb.) and per lb. Starch Equivalent. In addition, there is a Table giving Farm Values per ton of home-grown foodstuffs together with their respective Starch Equivalents and Protein Equivalents (see p. 746).

The first table quotes average wholesale prices in London ex-mill or store, and these figures are, of course, different from those applying to small purchasers at local markets. A difficulty may therefore arise since a calculation is necessary before a purchaser can assess the real cost to him of a particular offer, and a series of calculations is necessary before relative costs of different feeding stuffs can be compared. Moreover, it is not every purchaser to whom manurial value represents a realizable or even tangible asset, so that with prices fluctuating

and variable from locality to locality, the official Table, useful as it is, has obvious limitations. A simple " ready reckoner " device is therefore a necessity if the scientific estimation of values is to be general among sellers and purchasers.

Several alternative procedures can be suggested for facilitating the calculation of real costs, but the simplest and best is a nomogram. The essential calculation required is as follows:—

Let x = price in £ per ton or shillings per cwt.
y = starch equivalent.
z = cost per lb. starch equivalent in pence.

then

$$z = \frac{x \times 240 \times 100}{2240 \times y} = \frac{10 \cdot 71x}{y}$$

or $\log z = \log 10 \cdot 71 + \log x - \log y \qquad \text{(ii)}$

(x may be gross price, price plus carriage, or price less manurial value, according to which affords the most significant information.)

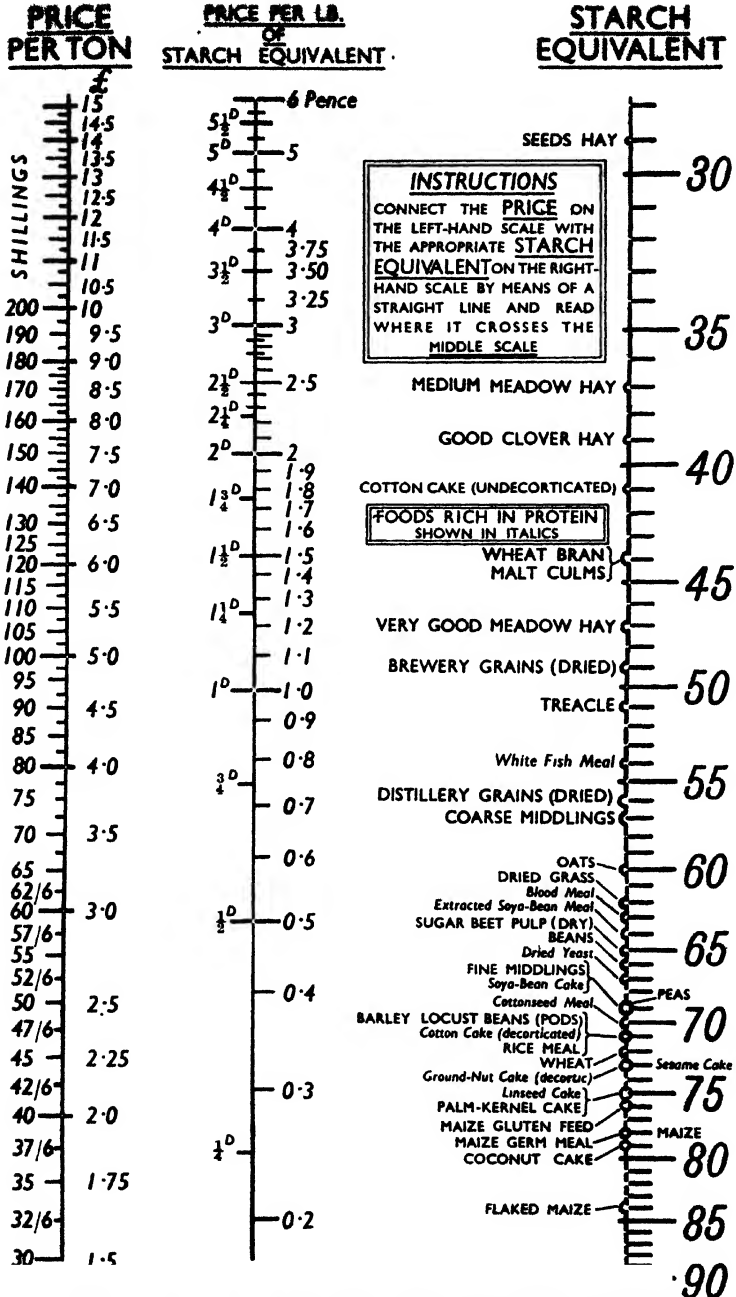
There is no need here to describe the computations involved in constructing a nomogram to fit this case. The subject is dealt with in mathematical books, e.g., Feldman's Biomathematics. Once constructed it is very simple to use. It consists of three vertical lines graduated logarithmically and separated by distances which have to be determined by equation (ii). The right-hand scale represents Starch Equivalents and the names of individual feeding stuffs are inserted at the appropriate positions. The left-hand scale is graduated in £ (or shillings) and represents prices per ton (or cwt.). The middle scale is graduated in pence and fractions of a penny representing cost per lb. of Starch Equivalent.

Instructions for Use. Lay a straight-edge across the nomogram cutting the left-hand line at the appropriate price and the right-hand line at the Starch Equivalent and read off cost at the intersection of the straight-edge and the middle line.

The nomogram on a scale of about six inches to the verticals will be found to be visible and accurate enough for all ordinary purposes.

A large number of feeding stuffs are bought—to some extent at least—because they are rich in protein. The Starch Equivalent is therefore far from reflecting accurately their real value to the livestock feeder, and, accordingly, such materials are shown in italics.

This leads us to the problem of assessing true relative costs



NOTE. The copyright in the above nomogram is strictly reserved to the authors.

for protein-rich feeding stuffs. A simple solution of this question is not possible because the matter is more complicated, to pure science and practical farming alike, than the problem of starchy food. Farm crops in the form of roots and cereals are low in protein in comparison with their starch content, whereas foodstuffs rich in protein are usually manufactured products and tend to be more expensive.

The "Table of Farm Values" in this JOURNAL is based on the method used in the *Report of the Departmental Committee on Rationing of Dairy Cows* for calculating how the cost of feeding stuffs should be distributed between Starch Equivalent and Protein Equivalent and the method of computation is described in each issue of the JOURNAL.

The method lays no claim to precision and it has obvious defects. It has, nevertheless, proved very serviceable for the particular purpose for which it was intended. The validity of the computation of Farm Values on this basis rests largely on the fact that, with the exception of leguminous crops, protein equivalents of ordinary home-grown foods are below 10, and the ratio of starch value to protein value is wide.

The method cannot safely be used for the valuation of cakes and meals, and is on the whole inapplicable to the general problem of protein costs (Whether the ratio is quoted as the "nutritive" or "nitrogenous" ratio or as that between Starch Equivalent and Protein Equivalent does not seriously affect the argument. For the sake of simplicity the latter [S.E./P.E.] is used here.)

In order to reach any degree of exactitude, the question must be approached from another angle It may be assumed with confidence that protein will cost more than starch. Starch is used as a fuel (providing calories) and although protein *can* be used as an almost equivalent fuel (weight for weight) it *ought* to be used largely to replace wear and tear of body tissues in *maintenance* and to perform its essential function of producing flesh, milk, eggs, etc. It is agreed that the use of protein as a fuel is uneconomic and physiologically undesirable.

The requirements of stock are fairly well known in terms of Starch Equivalent and Protein Equivalent. The farmer's problem now is not so much how to balance the two correctly as to find the cheapest sources of each. A very wide range of foods is available from which to balance a ration, but there is also a very wide range of possible costs of the mixture.

The Concentration Effect. Examination of the Table of Farm Values shows at once that with highly productive live stock it is practically impossible using home-grown feeding stuffs alone to achieve a sufficiently narrow ratio between starch and protein for the rapid production of milk, eggs and meat which the modern feeder demands. Bulky foods, such as hay and roots show a wide ratio of 8 : 1 or even 20 : 1. The average ratio for cereals is about 9 : 1, and for milling offals from 4 : 1 to 5 : 1. For a 4-gal. cow the total ration should possess a ratio of 5.5 : 1, and this will be narrowed for high-yielding cows. A high level of production thus involves the use of more protein than can be brought into a diet composed of farm products and cereals alone unless the starch intake is excessive. In this situation the artificial feeding stuffs possess great value because their high protein equivalents permit very readily of a narrowing of the Starch Equivalent/Protein Equivalent ratio. This allows the total ration to carry more of the cheap starchy foods like hay, oat straw and maize.

The accepted method of calculation, based on the solution of simultaneous equations, assumes an equal value for cereal protein and " cake " protein. This is unsound in principle because the value of the latter depends, as we have seen, firstly on the fact that it represents a definite weight of protein, and secondly on the fact that it is a *concentrated* protein foodstuff. Special emphasis must therefore be laid on the principle that a high protein equivalent has practical significance in addition to and independent of the value of protein as an ordinary ingredient in a ration. The extra value of a high protein equivalent may be described as an "enriching effect" or a *concentrating effect.* The latter term will be used here because it fits in with the idea of " concentrates " and indeed adds precision to a familiar expression. The " concentrating effect " may be defined as the provision of adequate amounts of protein within the limits imposed by the bulk (or the animal's appetite) by using a feeding stuff of high Protein Equivalent to correct a ration which would otherwise have too much starch and too little protein.

In order to illustrate this point, it can be assumed that the protein of mixed whole cereal is worth *a*/- per unit; bran protein (although still a cereal protein, unchanged in quality) will be worth a little more in virtue of the narrowed ratio giving definite concentrating power. The proteins of peas and beans will be still more valuable and so on :—

	Starch Equivalent	Protein Equivalent	Starch Equivalent / Protein Equivalent	Concentrating Power
Barley ..	71	6	circa 12	nil
Beans ..	66	19·7	3·3	moderate
Decort. Cottonseed Cake	68	34·7	circa 2	good
White Fish Meal ..	59	53	1·1	very good

It is not difficult to attempt a quantitative statement of the concentrating power. Clearly it will vary directly as the protein equivalent, and a *concentration index* will equal $k \times$ P.E. where k is a constant. Provisionally, it is suggested that $k = \frac{1}{9}$ i.e., concentration index $= \frac{\text{P.E.}}{9}$. The choice of $\frac{1}{9}$ is based on the fact that the protein equivalent of cereals and home-grown feeding stuffs rarely exceeds 9, so that the concentration index for the starchy products would be quite appropriately about 1. Such feeding stuffs are, moreover, adequate for maintenance, but not for high production. The choice of $\frac{1}{9}$ for k has, therefore, an underlying significance in stressing the important distinction between maintenance and production rations.

The concentration index will then be about:—

2 for legumes
3–4 for "cakes," etc.
6 for white fish meal
7 for meat meal
8 for blood meal.

The Quality Effect. *Protein* is not a word for a single chemical substance, but rather for a class of related but different materials. Each natural product, wheat, oats, maize, peas, cottonseed, etc., has its own kind (or mixture) of proteins. Maize protein and blood protein are no more interchangeable than potato protein and milk protein.

It is possible to split up the proteins into complex mixtures of simpler bodies, namely amino-acids. About 24 of these have been proved to exist in proteins, but no two proteins contain the same amino-acids in the same proportions. This gives rise to differences in quality, and quality to the stock feeder depends on the purpose in view, egg production, milk production, performing work or building tissue in meat production. It is necessary to provide those amino-acids which the animal needs for its own kind of production, especially since a number of amino-acids are *essential* in the sense that the animal must have them "ready made" as it cannot build its own characteristic proteins without them.

Normally, a ration of mixed foods will contain the essential amino-acids, but in the wrong proportions, with the inevitable result that in order to satisfy the need in respect of an acid present in too small amount, much excess of other acids will be consumed and to a considerable extent wasted.

There is urgent need for a great increase in the ease and accuracy with which feeding stuffs can be analysed for essential amino-acids.

There are three main methods of assessing the quality of protein. In the first (nitrogen balance method) chemical analysis of the excreta during starvation (when the animal is drawing on its own store of protein) enables the minimum maintenance requirement of nitrogen in the form of protein to be determined. If the amount indicated is provided in the ration, the protein will be " perfect " if the drain upon the animal's own store ceases without an increase in excretion of nitrogen. Such a protein is said to have a biological value of 100 per cent. A second method involves ascertaining the minimum amount of particular protein necessary for normal growth, whilst a third method depends on the proportion of the ingested food (protein) retained in the body (production).

The experimental work necessary to assess protein quality is difficult and tedious, and the various methods are not strictly comparable. Differences occur which are often difficult to explain, as will be seen by studying the following Table.

Method 1 (EMPHASIS ON MAINTENANCE)		**Method 2**		**Method 3** (EMPHASIS ON PRODUCTION)
Biological Values		*Minimum Protein Percentage in Ration for Normal Growth*		*Increase in Weight / Protein Intake*
Whole Milk	90–95	Whole Milk	6·9	Animal Proteins, 2·5–3
Whole Egg	94	Meat	10–15	Cereal Proteins, 1·3*
Meat	80–85	Barley	8–10	Legume Proteins, 1·5
White Fish Meal	74	Hemp Seed	12–15	
Barley	60–70	Wheat Germ	10	
Cottonseed	66–78			
Maize	67	*For Maintenance*		
Oats	70	Milk	3–4	
Wheat	66	Cereals	6	
Wheat Bran	57			
Wheat Germ	69			
Peas	69			
Potatoes	70			
Soya Bean	64			
Lentils	58			
Yeast	86			

* Average.

There can be no doubt that animal protein shows a quite marked superiority over vegetable protein, but it is difficult to discern any very decisive superiority or inferiority as between cereals and legumes. There is scope for much research on these lines, particularly as applied to cakes and meals. Judicious mixture of proteins often gives unexpectedly good results, which have sometimes been traced to the fact that deficiencies in particular amino-acids are corrected. (In this discussion no notice is taken of mineral or vitamin content.)

It is believed that all the essential amino-acids have now been recognized, but neither the proportions needed for particular purposes nor the proportions available in different proteins are known with sufficient exactness for a real solution of the problem of quality.

How, then, can existing knowledge be best utilized? Assumptions must be made for the purpose of simplification:—

(1) Protein Equivalent of cereals should be allotted no value in estimating real costs. In other words, the protein of cereals should be "taken in" at the price of Starch Equivalent, because in broad terms such protein, like that of most home-grown foodstuffs, is useful almost exclusively for the maintenance side of a ration.

(2) In virtue of the fact that protein-rich foods are bought mainly for protein, the comparison of different products is best made as follows: —

(*a*) allot to non-protein starch equivalent (i.e., S.E. minus P.E.) the value it would possess if it were cereal starch equivalent,
(*b*) subtract this value from the total price and calculate the cost per lb. protein

(3) Since "quality" of protein depends (*a*) on the purpose in view and (*b*) on the composition of the rest of the dietary protein, i.e., that automatically consumed as inseparable from hay, roots and cereals, no generally valid scale of quality is possible. It would, however, be an advance if first-class animal protein (meat meal, fish meal, fibrinogen meal used sparingly and with discrimination) could be regarded as worth twice as much as the vegetable protein of cakes and legumes (leaving out, of course, the value associated with the concentration effect, see below).

Provisional Basis of Valuation for Proteins. Let it be assumed that Starch Equivalent and cereal protein are ***worth*** the same, say 1*d*. per lb., or, since prices fluctuate, 4 value

points, and let extra points be allotted for concentrating power and for quality.

Example:—

	Protein Equivalent	Concentration Index	Quality Points	Total Points		4 Points 1*d*
						d
Cereals ..	7–9	1	0	4	4	1
Legumes ..	18–20	18/9=2	0	4+2	6	1½
Dec Ground-nut Cake ..	41·3	41 3/9= 4 5	0	4+4·5	8·5	2·125
Dec. Cotton-seed Cake ..	34 7	34 7/9=3 7	0	4+3·7	7·7	1·925
White Fish Meal ..	53	53/9=6	4	4+6+4	14	3½
Fibrinogen Meal ..	75	76/9=8	4	4+8+4	16	4

Procedure For Ascertaining Comparative Costs.

STEP 1. Make a list of the feeding stuffs of low Protein Equivalent (less than 10) to be considered. Note the prices, deduct manurial values, and then, using the nomogram, work out the respective costs of 1 lb. Starch Equivalent. From the results, decide what is the highest price which can be entertained for 1 lb. Starch Equivalent (*a* pence).

STEP 2. Make a list of the feeding stuffs rich in protein which are to be considered, noting price per ton (£*x*). In each case subtract Protein Equivalent from Starch Equivalent, and calculate the value of this (the non-protein starch equivalent) in £ per ton at the cost decided upon in STEP 1. (The nomogram can be extended to save this calculation.) Lay a straight-edge at *a* pence on the middle scale, connect with Starch Equivalent minus Protein Equivalent on the right-hand scale and read off on the left-hand scale. Result, £*y* per ton. £*x-y* will be the price of the protein part of the feeding stuff. Now lay a straight-edge connecting £*x-y* with the Protein Equivalent and read off on the middle scale the *cost* of 1 lb. ***protein.***

STEP 3. Determine the relative usefulness of the different protein-rich feeding stuffs by allotting points to allow for concentration index and quality.

(*a*) Points for the concentration effect are determined by the quantity:
$\frac{\text{P.E.}}{9}$, one-ninth of the Protein Equivalent

(*b*) Points for quality are in the general case given only to first-class animal protein, namely 4 points

Count up the points, allowing 4 + concentration index + quality points, if any.

STEP 4. Divide the cost of 1 lb. protein reached in STEP 2 by the number of points allocated to the feeding stuff in STEP 3, obtaining in this way price per "point."

In special cases, e.g., milk production where the quality factor is largely concerned with the proportion of the amino-acid lysine in the proteins, a special scale of quality can be devised. The idea of giving "quality points" only to good animal protein is conservative.

It is not suggested that all stock feeders who have mastered the intricacies of balancing rations should follow this method, but that those whose business it is to buy or sell large quantities of foods could analyse their costs with much greater precision than at present.

SUMMARY

(1) A nomogram has been constructed so that the cost of 1 lb. of Starch Equivalent may be obtained readily for feeding stuffs.

(2) The value of protein to the livestock feeder has been analysed into three aspects:—

(*a*) its value as protein irrespective of its admixture with fibre and non-protein substances. Reasons are given for regarding this value as practically the same as that of an equal weight of Starch Equivalent;

(*b*) its value as a protein-rich foodstuff capable of narrowing the $\frac{\text{S.E.}}{\text{P.E.}}$ ratio of a mixed diet. This value is given some precision as the concentration index, i.e. $\frac{\text{P.E.}}{9}$ and when $\frac{\text{P.E.}}{9}=4$ the value described under (*a*) is doubled;

(*c*) its value as a source of essential amino-acids present in sub-optimal amounts in the rest of the ration. This is a quality factor, and provisionally special value is attached to good animal protein.

OCTOBER ON THE FARM

R. W. Wheldon, D.Sc.,
King's College, Newcastle-upon-Tyne

On the majority of farms the present month sees a turn-over to winter management. Animals become dependent on hay, roots, winter grazing and purchased feeding stuffs. The amount of food available on the farm varies in different parts of the country. In the south and south-east, the dry season has resulted in short hay crops, and roots appear to be a variable crop, so that farmers are faced with either reducing the head of stock or becoming dependent on larger amounts of purchased foods. In the north and north-west, while hay is more abundant, much of it is very inferior material. On quite a number of farms, even at the time of writing, hay-making is not completed. On the other hand, many of the root crops in the north are promising well.

The general outlook for the winter cannot be said to be favourable as far as home-produced feeding stuffs are concerned, but it is fortunate that purchased concentrates are likely to be available in quantity at a lower price than for the past two or three seasons. Corn crops in many parts of the country have finished well and have been secured in good condition. In the north and west, while serious damage has not occasioned, harvesting has been rather slow, due to unfavourable weather, and now, in the middle of September, there still remains a considerable quantity of corn to be gathered. Farmers who depend largely on the sale of cattle and sheep in late summer and autumn have had to face poor market prices, and in most instances little has been obtained for summer keep. Prices continue low for both beef and mutton, but pigs and poultry products appear to be giving a more satisfactory return.

Winter Feeding. This should be planned to utilize food to the greatest advantage. Some classes of stock, if they are to give economic returns, demand good food. This applies particularly to cattle under twelve months old, to dairy stock and to animals in the later stages of fattening. The food of poorer quality might be reserved for older stock and dry breeding cattle. It should be borne in mind that it is at the end of the winter season that stock tend to suffer most, and,

where possible, some good food should be reserved. On the other hand, if animals are allowed to fall off in condition seriously in the early part of the winter, it is very expensive to make it up later.

Dairy cattle tend to fall off in yield at this time of the year, and the pasturage that may be available is normally of comparatively low feeding value. Cows should therefore be fed according to yield and a careful check kept. Any serious reduction at this time of the year is very difficult to regain and has a bad effect on the winter milk supply. Dairy cattle are frequently housed at night at the end of September or beginning of October, and here again care needs to be taken that the change is not too sudden. It sometimes happens that cattle are first brought in during wet weather. The experience of most milk producers is that cows tend to fall off in yield temporarily when they are first brought in, and they will probably suffer more if brought into the sheds on a wet day and housed when they are wet. If care is not taken to keep the sheds cool and well ventilated, the warm, moist atmosphere that results is very harmful to the cows, especially after they have been accustomed to being out-of-doors. Out-lying stock should receive hay or other food as soon as they will take it readily. A small allowance given to cattle out-of-doors in the early part of the winter keeps them going, and the animals are in a better condition to face adverse weather. If the animals are forced to consume poor pasturage, they may lose condition and require a much larger allowance of hay after the pasture has been consumed. Withholding the hay ration until the pasturage is finished is frequently uneconomical; it is usually better to keep both going during the winter. Balanced feeding and proper attention have a great effect on the well-being of animals. It is well known that a good stockman is likely to get better results with less food than a poor stockman with an abundance of food, and it is attention to the many little details connected with the management of stock that counts so much in the end. Feeders are well advised to consult the Agricultural Organizer as to the suitability of the rations they propose to feed during the winter season.

Winter Cultivation. As has previously been pointed out in these Notes, favourable soil conditions play a most important part in crop production. The autumn of 1937 was most

favourable for the sowing of winter cereals, and crop results have been good. So far, conditions during the present autumn are favourable and it is desirable that the fullest use should be made of the present opportunity to proceed with autumn ploughing, etc. The effect of cultural implements on many soils in a damp state may be most harmful and, while fixed rules for cultivation cannot be laid down, the object should be to leave the land in a friable condition, so that both air and moisture are available to the roots of the plants. With some crops a firm soil is also desirable. Cultivations during wet weather on many soils have the effect of causing the land to run together, with the result that air is excluded from a very large portion of the soil. On strong lands many farmers affirm that one day's work during good weather in the autumn is worth three in the spring. The effects of faulty drainage can more readily be noted at the end of the summer, and to get the best results from drainage in the following year it is desirable that the work should be done early. It takes some time for land to settle down and for drains to operate efficiently, and draining work done now will have the effect of keeping land dry during the winter. Spring drainage, while it may remove the water, does not leave time for the land to recover from the winter waterlogging.

Farmyard Manure. On the majority of farms this valuable substance is not available in sufficient quantity, and the quality is often poor. Much can be done by management to conserve farmyard manure of good quality. Badly stored farmyard manure may decompose wastefully in the winter, with the loss of much weight and manurial value. On some farms the whole of the urine is wasted, and as the greater part of the nitrogen and potash consumed by the animal is found in the urine it is desirable that everything possible should be done to conserve it. As farmyard manure decomposes more readily when exposed to the air, heaps or middens made in the field should be carefully built so that as little surface as possible is exposed. We are fortunate in this country in having a wide range and abundant supplies of artificial fertilizers to supply nitrogen, phosphates and potash, but farmyard manure is a farm-produced product of great value, and every effort should be made to prevent its waste.

Disease. Before and during harvest farmers may have found amongst corn crops signs of disease which had passed

unnoticed. It often happens that a crop looks well in the early stages but shows signs of failure at harvest. For example, lodging in patches in a field is sometimes due to a fungus (*Cercosporella*) that attacks the base of the straw, while premature ripening of straw with shrivelled or no grain in the ears results from attacks of other fungi at the roots and bases. As these fungi persist in the soil, it is important that the troubles be given due consideration and advice sought, since their attacks on a second straw crop may be disastrous. Mildewed straw (with mould growth on the exterior) has been extremely prevalent. Most farmers now dress seed corn with a mercury powder preparation or buy seed ready treated. It should be remembered that, as a rule, this favours germination, giving stronger seedlings, and subsequently a closer stand, so that such corn should not be sown too thickly. Individual plants have room for healthy development and so withstand bad weather and mildew better. As sowing time again approaches it may be well to remind growers of the advantages of treating the seed corn for prevention of Bunt (Stinking Smut) which can seriously reduce the quality and price of the crop.

With root crops, Club Root, where present, will be favoured by recent wet weather. Lime is the remedy for the farmer's use, but it must be remembered that it must be used under certain conditions if it is to be effective. Some farmers may be able to replace some or all of the turnips by kale, which is much more resistant to this disease than roots, or use some of the resistant varieties of turnips and swedes in addition to liming. The question of liming calls for present decision, as it should be applied as soon as the roots are cleared. Other diseases, such as Brown Heart, indicating boron deficiency, and Dry Rot due to a fungus (*Phoma*) may be seen at lifting time. It is well not to ignore these troubles but to obtain advice as to future management. When bacterial rots appear in the field, affected roots should not be clamped as the rot spreads during storage.

Potatoes. Blight has been extremely prevalent in the north and west, and it is feared that much rotting of tubers will occur in the clamps. Great care should be taken to dry off tubers before leading in, and as far as possible to exclude unsound tubers when picking.

MISCELLANEA

Holidays with Pay Act, 1938: Holidays with Pay for Agricultural Workers in England and Wales

The Holidays with Pay Act, which received Royal Assent on July 29, gives legislative effect to certain of the recommendations contained in the unanimous report* of the Committee of Enquiry appointed by the Minister of Labour in March, 1937, under the chairmanship of Lord Amulree, "to investigate the extent to which holidays with pay are given to employed workpeople and the possibility of extending the provision of such holidays by statutory enactment or otherwise, and to make recommendations." The Act, a summary of the main provisions of which is given below, empowers, *inter alia*, the Agricultural Wages Committees to provide for holidays and holiday remuneration for agricultural workers.

Notices of the Draft Regulations which will be required for the purposes of giving effect to the Act, as regards agricultural workers in England and Wales, were published in the *London Gazette* for September 6. The Rules Publication Act apply to these regulations and they cannot, therefore, be made until the 40 days period of notice required by that Act has expired. It is anticipated that they will be made towards the end of October.

Summary of the Provisions of the Act. *New Powers of Wage-Regulating Authorities in respect of Holidays with Pay.* The first three Sections of the Act carry out the recommendations of the Amulree Committee that Trade Boards and Agricultural Wages Committees in England and Wales and in Scotland should be empowered to provide for holidays with pay for the workers for whom they prescribe minimum wages. In addition, similar powers are given to the Road Haulage Central Wages Board set up under the Road Haulage Wages Act, which received the Royal Assent on July 13 of this year.

Section 1 of the Act gives the wage-regulating authorities mentioned power to direct that any workers for whom they are fixing or have fixed minimum rates of wages or statutory remuneration shall be entitled to be allowed holidays. These holidays shall be of such duration, subject to certain limitations, as the authorities may direct, and the direction may also

* Cmd 5724 H M Stationery Office Price 1s. 3d (1s. 5d. post free).

contain provisions as to the times at which and the circumstances in which such holidays shall be allowed. The first of the limitations on the duration of the holiday is that it must be related to the duration of the period for which the employer who is required to allow the holiday has employed the worker or has engaged to employ him. The second limitation, which does not apply to directions made by the Road Haulage Central Wages Board, is that the holidays to which workers are to be entitled shall not exceed one week in any period of twelve months, " week " meaning in the case of workers coming under the Agricultural Wages Committees seven days, and in the case of workers coming under the Trade Boards a normal working week. A third limitation applies only to directions given by the Agricultural Wages Committees. These may not provide for holidays of continuous periods exceeding three consecutive days. All holidays allowed to a worker under any direction shall, unless the direction otherwise provides, be in addition to any other statutory holidays to which he may be entitled, e.g., under the Factories or the Shops Acts. The penalty for any contravention by an employer of a requirement to allow a worker a holiday shall be a fine not exceeding £20.

Section 1 of the Act having given the authorities power to provide for the granting of holidays, Section 2 ensures that all such holidays shall be holidays with pay. Whenever one of the authorities uses its power to make a direction providing for holidays, it " shall make provision for securing that the workers shall receive pay in respect of the period of the holiday." The necessary power to fix " holiday remuneration," as it is called in the Act, is accordingly granted to Trade Boards and Agricultural Wages Committees, the Road Haulage Central Wages Board having already been granted such powers by the Road Haulage Wages Act. Section 2 also provides that the holiday remuneration shall both accrue and become payable at the times and subject to the conditions laid down by the authorities.

Section 3 provides that the procedure in connexion with directions and rates shall be that set out in the Trade Boards Acts and the Agricultural Wages (Regulation) Act according as the wage-regulating authority is a Trade Board or an Agricultural Wages Committee. The procedure in connexion with directions given by the Road Haulage Central Wages Board is that laid down in the Road Haulage Wages Act, 1938. The

appropriate Minister is given regulation-making powers which enable him to apply for the purpose of the Holidays with Pay Act, with or without modification, any provisions of the Trade Boards Acts, the Road Haulage Wages Act, or the Agricultural Wages (Regulation) Act.

Amongst other provisions is one giving power to the Minister of Labour to assist voluntary holiday schemes.

The Training of the Veterinary Surgeon

The Committee appointed in November, 1936, jointly by the Secretary of State for Scotland and the Minister of Agriculture, to review the facilities available for veterinary education in Great Britain in relation to the probable future demand for qualified veterinary surgeons and to make recommendations as to the provision which should be made from public funds in the five years 1937-42 in aid of the maintenance of institutions providing veterinary education, has now issued its report.* The Committee estimates the annual farm live stock losses in the United Kingdom from diseases as some £19,000,000 and emphasizes the importance to national health, security and wealth of a well-trained veterinary profession. It estimates the annual demand for newly qualified veterinary surgeons during the five years 1937-38 to 1941-42 at about 150, and some 115 thereafter. If the number of students in the veterinary schools is maintained at its present level, it will eventually produce a supply of qualified men in excess of demand so that a progressive reduction in the student numbers in Great Britain to a total of 800 is recommended.

The Committee's recommendations include a reorganization of the curriculum for the five-year course for the Diploma of Membership of the Royal College of Veterinary Surgeons (the professional qualification) to secure such an arrangement of the subjects as will, *inter alia*, enable the first three years to be devoted to a combination of scientific studies in which Universities may award degrees; the final two years' studies being devoted to practical work and clinical training. The proposals for facilitating the taking of a University degree *en route* to the M.R.C.V.S. link up with other proposals for securing a more organic connexion of universities with veterinary education, which include some reconstitution of the Council and Examination Committee of the R.C.V.S.

* *Report of the Committee on Veterinary Education in Great Britain.* H.M. Stationery Office Price 2s. 0d net

The Committee points out that the maximum size of a veterinary school must largely be dictated by the requirements of clinical instruction, and it considers that the three present state-aided schools (London, Edinburgh and Liverpool) cannot efficiently teach as many as 800 students, so that a fourth school is required. The situation of the schools is not regarded by the Committee as ideal; their removal, however, does not appear practicable and recommendations are made to remedy the deficiencies arising from their location. The Committee recommends that, with a complete reorganization and rebuilding of the existing school at Glasgow, a fourth state-aided school should be situated there, with provision for carrying out pre-clinical teaching in the University, leaving the reorganized school to concern itself with the final two years' practical and clinical training. In addition, state-aid is recommended to establish veterinary teaching at Cambridge University, excluding clinical training, but embracing both pre-clinical training and a post-M.R.C.V.S. year devoted to advanced animal pathology and to specialized study in one of the related sciences.

Considerable attention was paid by the Committee to the studies of the final two years of the M.R.C.V.S. course and to the improvement of the practical and clinical facilities for training. Its recommendations include the acquisition by the veterinary schools of adequately stocked and equipped field stations in rural areas to secure practical training in animal husbandry, and, in view of the serious defect in the students' training arising from the lack of clinical material, the establishment of properly staffed and equipped hospitals for large animals adjoining the field stations in the rural areas.

Other recommendations deal with advanced post-diploma courses, refresher courses and the establishment of a six months' post-graduate course in poultry disease and poultry husbandry. The encouragement and improvement of research so far as the schools themselves are concerned is also dealt with.

The estimated capital cost of the building and equipment programme covered by the Committee's recommendations is placed at £299,000, and increased state-aid towards the maintenance of veterinary education is recommended by annual grants rising to approximately £61,000 when the reorganization of the schools has been completed at the end of the five-year period.

National Rat Week, November 7-12, 1938

National Rat Week begins this year on Monday, November 7, and the Ministry asks everybody to make a special effort during that week to destroy rats and mice and to take all possible steps to secure concerted action to bring them under control.

Section I of the Rats and Mice (Destruction) Act, 1919, imposes a statutory obligation upon every occupier of any land, buildings or other premises to take steps to destroy any rats or mice on the property which he occupies or to prevent such property from becoming infested. Over 700 local authorities in England and Wales are empowered to enforce the Act in their respective districts, and the Ministry has invited these authorities to co-operate in this year's campaign of destruction and has offered suggestions as to special measures that may be taken in connexion with municipal rubbish dumps, sewage farms, and other places which are particularly liable to infestation by rats.

Arrangements have been made for local authorities to be supplied with copies of an illustrated " National Rat Week " poster, literature on the subject of rat destruction, and the loan of copies of the cinematograph film " Your Enemy the Rat," illustrating the depredations of rats and methods for their destruction.

The Ministry's Advisory Leaflet, No. 49, *Destruction of Rats and Mice*, contains much useful information and advice, and a copy of this leaflet, together with a pamphlet containing simple suggestions for rat destruction, and a list of suppliers of suitable poisons, etc , may be obtained free of charge on request from the Ministry, 10, Whitehall Place, London, S.W.1.

Further information on the subject of rats is contained in Bulletin No. 30, *Rats and How to Exterminate Them*, copies of which are obtainable through any bookseller, or direct from His Majesty's Stationery Office, York House, Kingsway, London, W.C.2, price 6*d*. (7*d*. post free).

Progress of the Land Fertility Scheme

The number of applications for contributions under the Land Fertility Scheme received from occupiers of agricultural land in the United Kingdom now exceeds 241,000. The quantities of lime and basic slag in respect of which these applications have been made are approximately 1,535,000 tons of lime and 459,000 tons of basic slag.

Sale of Diseased Plants

The sale or exposure for sale of any plants substantially affected by certain pests and diseases has been prohibited for some 17 years under various Orders made by the Ministry under the Destructive Insects and Pests Acts, 1877 to 1927. Under the Sale of Diseased Plants Orders of 1927 and 1936, which are at present in operation, it is an offence to sell, offer or expose for sale, or, having sold, to deliver for planting:—

(*a*) any plant substantially affected by certain specified insects or pests;
(*b*) any plant which bears evidence of having been substantially affected by the Apple Capsid,
(*c*) any tomato or cucumber plant substantially affected by the Greenhouse White Fly, and
(*d*) any potatoes or Narcissus plants or bulbs which are visibly rendered unfit for planting by reason of their being or having been affected by any insect or pest

The provisions of the Orders relating to Narcissus bulbs and potatoes were introduced in 1936, with the object of improving (i) the health of home-grown bulbs with a view to enabling the English bulb industry more effectively to meet the competition of imported bulbs, the health standard of which is maintained through the operation of the Importation of Plants Orders, and (ii) the general standard of health and freedom from diseases of seed potatoes.

During each of the years 1936 to 1937, the Ministry's inspectors paid more than 2,500 visits to nurseries, markets, auctions, shops and similar premises at which plants were exposed for sale, but in very few instances was it found necessary to take action leading to the destruction or treatment of plant material owing to the presence of disease. In addition, a considerable number of cases were investigated in which complaints had been made by grower-purchasers that seed potatoes which had been delivered to them were unhealthy. In many of these cases the potatoes were found to be visibly rendered unfit for planting and appropriate action was taken to prevent the planting of the unhealthy material.

Reports received by the Ministry indicate that the Orders have had the effect of ensuring that the great majority of plants now exposed for sale may be relied upon as being substantially free from the particular pests scheduled under the Order of 1927, and there are good reasons for hoping that with the continued co-operation of the trade the provisions of the later Order concerning potatoes and Narcissus bulbs will in course of time achieve equally beneficial results.

Scholarships for the Sons and Daughters of Agricultural Workmen and Others

The selection of candidates for this year's awards under the Ministry's scheme of scholarships for the sons and daughters of agricultural workmen and others has now been completed. The total number of applications received was 570, and 139 scholarships have been awarded. These awards were allocated as follows: 10 Senior scholarships tenable at University Departments of Agriculture or Agricultural Colleges for Degree or Diploma courses in agricultural subjects; 10 Extended Junior scholarships of one year in duration for advanced or specialized courses of instruction at Farm Institutes or Agricultural Colleges; and 119 Junior scholarships tenable at Farm Institutes and similar institutions for courses not exceeding one year in Agriculture, Horticulture, Dairying or Poultry Husbandry, or in a combination of two of these subjects. The following obtained Senior Scholarships:—

DEGREE COURSES

PETER R BELL (Simon Langton's School, Canterbury).	Cambridge University.
ALBERT J DAVIES (University College of Wales).	University College of Wales, Aberystwyth
THOMAS H ELLIS (Madryn Castle Farm School)	University College of North Wales, Bangor
DAVID T EVANS (Pibwrlwyd Farm Institute).	University College of Wales, Aberystwyth
MARGARET J. HOWDEN (Blyth Secondary School, Norwich)	Horticultural College, Swanley
FREDERICK H KELSEY (Herbert Strutt School, Belper)	Royal Veterinary College
FLORENCE J. PIPER (Bridgnorth Grammar School)	Horticultural College, Swanley

DIPLOMA COURSES

DAVID L. JONES (Staffordshire Farm Institute).	Midland Agricultural College
GEORGE W. MANN (Midland Agricultural College).	Leeds University.
WILLIAM A. WALSH (Cheshire School of Agriculture).	Leeds University

The New Series of Index Numbers of Agricultural Prices

The new series of index numbers of agricultural prices to which reference was made in the March, 1938, issue of this JOURNAL (p. 1154), has now been completed, and a special

booklet* has been published explaining the changes which have been effected. These changes are illustrated by a series of tables covering the years 1927-37 inclusive and showing the monthly and annual prices and index numbers of the various commodities included in the index, and the weights used in the calculation of the general indices. They provide a comparison between the old series of annual general index numbers and those of the new series. Reference should be made to the booklet for full information concerning the new series and the variations from the old series effected by the revision. The principal changes are briefly set out below.

The base period, which for the old index was 1911-13 = 100, has been changed to 1927-29 = 100. Additional commodities are included, the principal of which are sugar-beet and glass-house produce, while one or two products, the importance of which has diminished, have been omitted. The monthly index, which has hitherto been computed by comparing the monthly price with the price in the corresponding months of the base period, is now calculated by comparing the monthly price with the annual base (1927-29) price, and an additional monthly index is published, designed to show the trend of prices after the customary seasonal variation in price has been eliminated. The weighting used for the compilation of the general index numbers is derived from the average annual output over the latest period of five years for which the output has been estimated; thus, the weights will tend to vary slightly from year to year instead of being on a fixed scale as in the old series. This modification will secure that the weighting is kept up to date.

During the new base period (1927-29) the average annual general index in the old series was 145 and the following comparative table shows the annual indices for 1927 to 1937 inclusive (*a*) in the old series (*b*) in the new series and (*c*) the old series scaled down in the proportion of 100 : 145.

In addition to the publication in the *Agricultural Market Report* of the two sets of monthly index numbers (corrected and uncorrected for seasonal variation), the actual prices from which the index numbers are calculated will also be published each month. The prices used are, as a rule, the average of first and second quality, as published each week in the

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* *Index Number of Agricultural Prices.* Obtainable through a bookseller or from H.M. Stationery Office. Price 9*d*. net.

Agricultural Market Report. For the milk index in the new series, the pool price under the Milk Marketing Scheme is being

Year	Old Series	Old Series (adjusted)	New Series
1927	144	99	99
1928 .. .	147	101	102
1929	144	99	99
1930	134	92	91
1931	120	83	83½
1932 .. .	112	77	80½
1933	107	74	75½
1934	114	79	77
1935 .. .	117	81	78½
1936	122	84	80½
1937	133	92	89

used, as this reflects the average actual return to the producer in respect of his total milk sales. The use of the pool price, which is not available until about the middle of the following month, will entail some delay* in computing the milk price index, and in future, therefore, the monthly index numbers will normally appear in the *Agricultural Market Report* published in the fourth week of the month after that to which the index numbers relate.

MONTHLY INDICES IN 1938

Month	Old Series (Base Corresponding Months 1911–13 = 100)	New Series Corrected for Seasonal Variation (Base 1927–29 = 100)
January	134	90
February	130	89
March .	126	88
April	132	89
May ..	125	90
June .	124	90
July	132	94

For purposes of comparison, the above table shows for the months of January to July, 1938, the monthly general index compiled upon the old basis together with the corresponding index (corrected for seasonal variation) in the new series.

* This delay will make it impossible for up-to-date figures to appear in the JOURNAL, and the usual monthly table of index numbers will not, therefore, be published in future issues of the Journal

The Agricultural Index Number, August, 1938

The general index number of prices of agricultural produce for August at 125 (base, August, 1911-13=100) compares with 132 a month ago and 133 in August, 1937. If allowance be made for payments under the Wheat Act, 1932, and the Livestock Industry Act, 1937, the revised index is 130.

Monthly index numbers of prices of Agricultural Produce. (Corresponding months of 1911–13 = 100)

Month	1933	1934	1935	1936	1937	1938
January	107	114	117	119	130	134
February .	106	112	115	118	129	130
March	102	108	112	116	130	126
April .	105	111	119	123	140	132
May ..	102	112	111	115	133	125
June . ..	100	110	111	116	131	124
July . .	101	114	114	117	131	132*
August .. .	105	119	113	119	133	125
September . .	107	118*	120	127	137	—
October .	107	114	113	125	131	—
November .. .	109	114	113	125	133	—
December	110	113	114	126	132	—

Revised monthly index numbers of prices of Agricultural Produce allowing for payments under the Wheat Act (a) and for the Cattle subsidy (b).

Month	1933	1934	1935	1936	1937	1938
January	111	119	124	125	133	138
February . ..	110	117	122	123	133	135
March . .	106	112	118	122	134	131
April .	109	116	126	128	143	137
May .	105	116	117	120	136	130
June ..	104	114	117	121	134	129
July . ..	104	117	120	121	134	137*
August . ..	108	122	120	124	136	130
September ..	111	125	128	133	142	—
October .. .	112	121	119	129	134	—
November	113	120	119	129	137	—
December	114	120	120	130	136	—

(*a*) Commenced August, 1932. (*b*) Commenced September, 1934.

* Superseding figure previously published.

In the following table the monthly index numbers of prices of individual commodities are shown for the months of May to August, 1938, August, 1937, and August, 1936; base, the corresponding months of 1911-13 = 100.

Commodity	1938				1937	1936
	Aug	July	June	May	Aug	Aug.
Wheat	89	99	100	100	118	96
Barley .. .	129	120	138	137	147	100
Oats .. .	108	113	113	111	125	98
Fat cattle	112	111	110	111	119	102
,, sheep	93	97	100	110	141	128
Bacon pigs .. .	119	121	121	124	120	111
Pork ,, .. .	120	120	123	126	119	107
Eggs	145	150	133	133	138	130
Poultry	123	127	130	127	132	113
Milk	202	228*	175	175	175	175
Butter .. .	113	121	124	121	110	100
Cheese .. .	145	148	138	128	126	113
Potatoes . ..	112	152	172	170	127	109
Hay	92	85	83	79	97	98
Wool	94	90	89	95	147	95
Dairy cows ..	114	115	118	116	114	103
Store cattle ..	110	112	113	112	119	101
,, sheep ..	99	95	—	90	142	126
,, pigs	148	145	140	140	141	133

Revised index numbers due to payments under the Wheat Act and to the Cattle subsidy

Wheat .	122	123	125	125	124	124
Fat cattle ..	127	125	123	125	134	117
General Index ..	130	137*	129	130	136	124

* Superseding figure previously published.

Grain. Wheat averaged 7*s*. 1*d*. per cwt., a fall of 11*d*. per cwt. on the month, and the index declines by 10 points. If the deficiency payment under the Wheat Act, 1932, is taken into account the index is 122. Barley at 9*s*. 9*d*. per cwt. realized 9*d*. more than in July and the index advances by 9 points, but oats were reduced in price by 1*s*. 1*d*. to 7*s*. 7*d*. per cwt., and the index is 5 points lower. In August, 1937, wheat averaged 9*s*. 5*d*., barley 11*s*. 2*d*., and oats 8*s*. 9*d*. per cwt.

Live Stock. Fat cattle were again quoted lower, second quality averaging 37*s*. 11*d*. per live cwt. as against 39*s*. 4*d*. a

month ago; a more pronounced fall, however, occurred in the base years and the index is 1 point higher. The addition of the subsidy under the Livestock Industry Act, 1937, brings the index to 127. Second quality fat sheep realized ¼*d*. less at 6¾*d*. per lb. and the index is reduced by 4 points. Baconers, at 12*s*. 2*d*. per score (20 lb.) made rather more money but, with a greater advance in the months of August, 1911-13, the index falls by 2 points. Prices of porkers appreciated to 12*s*. 8*d*. per score and the index remains at 120. Both dairy cows and store cattle were cheaper during August, the relative indices declining by 1 and 2 points. Store sheep averaged 29*s*. 8*d*. and store pigs 33*s*. 9*d*. per head, the indices advancing by 4 and 3 points respectively.

Dairy and Poultry Produce. The regional contract price of liquid milk for the month under review was 1*s*. 3⅛*d*. per gal. and the index 202. Prices of butter rose by ¼*d*. to 1*s*. 2¾*d*. per lb., but, owing to a larger increase in the base period, the index falls by 8 points. Eggs were again higher in price, second quality averaging 16*s*. per 120; a proportionately greater advance, however, was recorded in the corresponding months of 1911-13, and causes the index to decline by 5 points. Cheese was unchanged at £4 19*s*. per cwt., but, with a rise in the base months, the index is 3 points lower. The combined index for poultry at 123 compares with 127 a month ago.

Other Commodities. Prices of first early potatoes showed a considerable reduction, the average of £4 10*s*. per ton being £3 19*s*. lower and the index falls by 40 points. Both clover and meadow hay were quoted higher, the combined index for hay advancing by 7 points. Wool at 12¼*d*. per lb., was somewhat dearer and the index is 4 points higher.

Seeds Act, 1920: Prosecution

Proceedings were taken by the Ministry at Ipswich on August 11 against a local firm of seedsmen for the sale of a quantity of White Clover seed which contained over 20 per cent. of an injurious weed seed (*Geranium molle*), whereas the Seeds Regulations prohibit the sale of seed containing more than 5 per cent. of such injurious weed seed. The Court found the case proved, but accepted the defendant's explanation that a mistake had been made and dismissed the case under the Probation of Offenders Act on payment of £3 costs.

The Ministry's Advisory Publications

Since the date of the list published in the July. 1938, issue of this JOURNAL (p. 407), the undermentioned Advisory Publications have been issued by the Ministry.

Bulletins:

No. 32.—Pig-Keeping. (5th Edition.) 2s. (2s. 3d. post free).
Substantially revised and enlarged in the light of recent knowledge.

No. 34—Mushroom-Growing. (4th Edition) 1s. 6d (1s. 8d post free).
The text of the previous edition has been entirely revised, and sections on substitutes for horse manure, preparation of the manure and the value of spent compost have been added

No. 49.—Intensive Systems of Apple Production. (4th Edition) 1s (1s. 2d. post free)
Largely rewritten Brings together recent experiences of the working of the intensive systems obtained as a result of experimental work and commercial practice.

No. 71.—Manuring of Vegetable Crops. (2nd Edition.) 1s (1s. 2d. post free).
In addition to revising some of the original text, the author has added a short note on the Indore process of compost making and included further information on the value of dried poultry manure.

Copies of the above are obtainable at the prices mentioned from the Sale Offices of H.M. Stationery Office or through any bookseller.

Advisory Leaflets:

No. 10.—Fruit Tree Red Spiders. (Revised)
No. 293—Rearing and Management of Young Horses (New)
No. 294—The Strawberry. (New)

Copies of any of the above-mentioned leaflets may be purchased from H.M. Stationery Office, York House, Kingsway, London, W.C.2, or at the Sale Offices of that Department at Edinburgh, Manchester, Cardiff, and Belfast, price 1d. each net (1½d. post free), or 9d. net per doz. (10d. post free).

Single copies of not more than 20 leaflets may, however, be obtained, free of charge, on application to the Ministry. Further copies beyond this limit must be purchased from H.M. Stationery Office, as above.

A list of the Ministry's publications, including bulletins and leaflets on agriculture and horticulture, may be obtained free and post free on application to the Ministry.

MARKETING NOTES

Milk Marketing Scheme: *Contract Prices and Terms, 1938-39.* In substance, the prices and terms of the contract prescribed for 1938-39 by the Milk Marketing Board, after consultation with the Central Milk Distributive Committee, are not materially different from those which were operative under the 1937-38 contract. The principal changes are referred to below.

Regional Wholesale Prices. The average of the wholesale prices is 16¼*d.* per gal. and is the same as last year, with the addition of the increase awarded to producers last July, which was equivalent to one-third of a penny per gal. over the year. Some of the monthly prices, however, have been modified compared with those of the last contract, the general effect of which is to introduce greater uniformity. The comparative monthly prices are as follows:—

	1937-38 *d per gal*	1938-39 *d. per gal.*
October	17	17
November to February	18	17½
March	17	17
April	16	16
May	13	13½
June	13	13½
July	17*	16
August and September	15	16
Unweighted average	16¼	16¼

Increased from 13*d* on the Certificate of the "consulted person."

An additional ⅛*d.* per gal. is to be paid on milk purchased during May, as the distributors' share of a joint contribution of ¼*d* per gal for milk publicity

Level Delivery and Accommodation Premiums. These premiums, which are the same as under the 1937-38 contract, are ½*d.* per gal. for a specified daily delivery with a maximum variation of 10 per cent.; 1*d.* per gal. for a non-fluctuating daily delivery; and 1½*d.* per gal. for a daily delivery—which may be variable—as agreed daily between buyer and seller.

Prices of Milk for Manufacture. Manufacturing milk prices under the 1938-39 contract are substantially the same as those in the last contract period. The prices of milk manufactured into milk powder (7*d.* per gal.), condensed milk (7½*d.* per gal.), soft curd and cream cheese, fresh cream, bottled cream and ice cream (8½*d.* per gal.) and "other products" (10*d.* per gal.) are unchanged. Milk for tinned cream, on the other

hand, is priced at $7\frac{1}{2}d.$ per gal., instead of as in the last contract period $7d.$ per gal. from October 1 to December 31, 1937, and $7\frac{1}{2}d.$ per gal. thereafter, while exported natural sterilized milk is not separately classified as it was before at $7\frac{1}{2}d.$ per gal., and is now, therefore, included under "other products" at $10d.$ per gal.

Prices payable for milk for the remaining products, namely, cheese, butter and condensed milk for export, are ascertained each month from formulae similar to those hitherto used, and are set out below.

Product	*Price per Gal.*
Cheddar Cheese manufactured from milk delivered in the months of October, 1938, to February, 1939 (inclusive), and September, 1939.	The weighted average less $1\frac{1}{4}d.$ of (1) the average price per lb for the previous month of Finest White New Zealand Cheese, and (2) the average of (*a*) the average price per lb. for the previous month of Finest White Canadian Cheese (excluding old and exceptional quotations), and (*b*) the average price per lb. for the previous month of Finest White Canadian Cheese New Season's Make, and to the resultant price there shall be added one halfpenny The weights to be used are the total imports of New Zealand and Canadian cheese, respectively, in the month preceding the "previous month"
Cheese (other than Cheddar cheese) manufactured from milk delivered in the months of October, 1938, to February, 1939 (inclusive), and September, 1939	One halfpenny more than the manufacturing price of milk for Cheddar cheese manufactured from milk delivered in the same month
Cheese manufactured from milk delivered in months other than those above-mentioned	The average price per lb. for the previous month of Finest White New Zealand Cheese, less the sum of $1\frac{1}{4}d.$ per lb.
Stilton Cheese and Blue Vein Cheese.	One penny per gallon more than the manufacturing price for Cheddar cheese manufactured from milk delivered in the same month.
Butter from milk produced outside Cornwall	The weighted average price per cwt. in the previous month of New Zealand Finest and Danish butters less 16*s*., divided by 265, in the months from October, 1938, to February, 1939 (inclusive), and in September, 1939, and by 285 from March to August, 1939, (inclusive), and to the resultant price there shall be added one-tenth of a penny, together with $\frac{1}{4}d.$ representing the value of separated milk

Product	*Price per Gal.*
	The "weights" to be used are the total imports of New Zealand and Danish butters respectively, in the month preceding the "previous month."
Butter from milk produced in Cornwall.	The above weighted average price of imported butters less 16*s*., divided by 225 in the months from October, 1938, to February, 1939 (inclusive), and in September, 1939, and by 245 from March to August, 1939 (inclusive), and to the resultant price there shall be added one-tenth of a penny, together with ½*d* representing the value of separated milk
Condensed Milk which has been exported.	A sum representing the manufacturing price (for the month in which the milk was delivered) of Cheddar cheese but with a minimum of 6*d*. and a maximum of 7½*d* per gallon.

The main differences in these formulae compared with those adopted in the 1937-38 contract are in the classification of the varieties of cheese to which the formulae apply, as a result of which the winter price of milk manufactured into certain varieties of cheese will be increased by ½*d*. per gal.; in the higher value attached to skim milk as a by-product of butter-making; and in the increased minimum price, namely, 6*d*. instead of 5*d*. per gal., of milk used for manufacturing condensed milk which is exported.

The above-mentioned prices are for milk which has been manufactured outside the larger towns and cities. If milk is manufactured in the Metropolitan Police district or the City of London, however, the price payable is increased by 1*d*. per gal., and, where milk, for which the scheduled price is less than 8½d. per gal., is manufactured in other towns and cities with more than 60,000 population, the Board may, if the scheduled price is not less than 7½*d*. and shall, if the scheduled price is less than 7½*d*. per gal., increase the price by not more than ½*d*. per gal.

Retail Prices. The prescribed minimum retail prices generally reflect the increase of one-third of a penny in the wholesale price, except in rural districts and in urban districts and boroughs with a population not exceeding 10,000, where the minimum prices will, on the average, be two-thirds of a penny per gal. more than those prescribed in last year's contract, and in certain towns in Lancashire where the minimum price will be 2*s*. per gal. during the five months April to

August, 1939, and 2s. 4d. per gal. during the remainder of the year.

Monthly retail prices in all districts, however, have been modified to give a more uniform level throughout the year, this process having been carried furthest in respect of districts with a population exceeding 25,000 in the south-eastern region, where a flat monthly price of 2s. 4d. per gal. will obtain during 1938-39.

Provisions for Varying Prices. The provisions for varying prices by agreement or on the Certificate of a Consulted Person, apply only to regional wholesale prices and manufacturing prices, but provision is made in this contract for consequential variations in minimum retail prices.

Tuberculin Tested Milk. The monthly regional wholesale prices payable to the Board by purchasers of Tuberculin Tested milk are in every case 2d. per gal. higher than the corresponding prices mentioned above for other milk. Similarly, the minimum retail prices for Tuberculin Tested milk are for the most part from 2d. to 4d. per gal. higher. Minor changes from last year's contract are that Tuberculin Tested milk delivered to an approved depôt does not bear any transit risk charge, and that a resolution of the Board to reduce the minimum retail price of Tuberculin Tested milk in any area is conditional on a reduction having been made in the minimum retail price of other milk in that area.

Farm Cheesemakers. In the 1938-39 contract for farm cheesemakers two important changes have been introduced. One is that producers who qualify will receive from the Board a premium of 1d. per gal. payable in respect of Tuberculin Tested milk made into cheese. The other is that the Board's payments to producers will differentiate between cheese which has and cheese which has not been graded under the National Mark. For National Mark hard cheese these payments will be 4¾d. per gal. from October 1, 1938, to April 30, 1939, and 3¾d. per gal. from May 1 to September 30, 1939; while for National Mark Caerphilly or National Mark soft cheese the payments will be ½d. per gal. less than these amounts. The sum payable on milk manufactured into farm cheese will be reduced by ¾d. per gal. if the cheese is not of National Mark standard.

Allocation of Contracts and Diversion of Supplies. The Board and the Central Milk Distributive Committee have agreed a plan as part of the 1938-39 contract, the general

principles of which are that buyers will be grouped in three categories according to the degree to which their businesses are concerned with the liquid milk market and with manufacture, and that contracts will be allocated so as to give priority to those serving the liquid market.

As a further means of safeguarding the liquid market, manufacturing rebates on milk manufactured into butter and cheese will not be payable if the buyer increases his intake over that of 1937-38, and will be payable only on a standard quantity of such milk if the buyer does not increase his intake. The standard quantity for this purpose during the period October, 1938, to March, 1939, is 60 per cent. of the quantity manufactured into cheese and 40 per cent. of the quantity manufactured into butter during the corresponding period of 1935-36; and during the months April to September, 1939, is 66⅔ per cent. of the quantity manufactured into butter and cheese during the corresponding month of 1936.

Lastly, milk may be diverted " on call " to the liquid or higher-priced manufacturing markets, either with or without premium, according to whether the buyer has not or has increased his intake.

Milk Marketing Board: *Prices for August* The wholesale price for liquid milk (other than Tuberculin Tested milk) in August, 1938, was 1*s.* 3*d.* per gal., 2*d.* less than in the previous month, but 2*d* more than in August, 1937; the wholesale price for Tuberculin Tested milk in August, 1938, was 1*s* 5*d* per gal, 2*d* less than in the previous month

Pool prices for August, 1938, are given below, with comparative figures for July, 1938, and August, 1937

	Pool Prices		
	August 1938 *d*	*July* 1938 *d*	*August* 1937 *d*
Northern	11½	12½	10¼
North-Western	11½	12½	10¼
Eastern ..	11¾	13	10¾
East-Midland	11½	12¾	10½
West Midland	11¼	12¼	10¼
North Wales	11¼	12½	10¼
South Wales	11½	12½	10¼
Southern ..	12	13	10¾
Mid-Western	11¼	12¼	10¼
Far-Western	11	12¼	10
South-Eastern	12	13¼	11
Unweighted Average	11·50	12·61	10·41

These prices are exclusive of any premium for special services and level deliveries, and also of the quality bonuses for Accredited and Tuberculin Tested milks. The estimated gallonage on which quality premiums have been earned was 39,238,963.

The inter-regional compensation levy was fixed at 1¼*d.* per gal., compared with 1*d.* per gal. in August, 1937. Sales on wholesale contracts were as follows :—

	August, 1938 (estimated) Gal.	August, 1937 (estimated) Gal.
Liquid	51,076,626	48,688,898
Manufacturing	32,093,477	26,648,343
	83,170,103	75,337,241
Percentage liquid sales	61·41	64·63
Percentage manufacturing sales ..	38·59	35·37

The average realization price of manufacturing milk during August, was 6·61*d.* per gal., compared with 6·26*d.* per gal. for August, 1937. The quantity of milk manufactured into cheese on farms was 3,295,852 gal., compared with 3,430,129 gal. in the previous month and 2,739,526 gal. in August, 1937.

Bacon Industry Act, 1938: *Licensing of Bacon Factories.* The temporary exemption from the licensing provisions of the Bacon Industry Act granted by the Bacon Development Board in respect of certain premises expired on October 1. After that date, it became an offence under the Act to produce bacon on any premises not licensed by the new Bacon Development Board or exempted by the Act or by a subsequent exemption of the Board.

Prescription of Standard Pig The Minister of Agriculture and Fisheries and the Secretary of State for Scotland, acting in conjunction, have made "The Bacon Industry (Standard Pig) Regulations, 1938," prescribing a "Standard Pig" for the purposes of long contracts to be made in accordance with the provisions of Section 26 of the Bacon Industry Act, 1938.

Wheat Act, 1932: *Sales of Home-grown Wheat—Cereal Year* 1938-39. Certificates lodged with the Wheat Commission by registered growers during the period August 1, 1938, to September 2, 1938, cover sales of 514,010 cwt. of millable wheat, as compared with 444,868½ cwt. in the corresponding period (to Sept. 3) in the last cereal year.

Final Deficiency Payment to Wheat Growers for 1937-38. The Wheat Commission despatched cheques on September 9 to 76,003 registered growers in respect of the final payment of deficiency payments for the cereal year 1937-38. The aggregate amount involved was approximately £1,189,800, but, after taking into account 646 further payments which, for various reasons, have had to be delayed pending investigations by the Commission of the title of persons claiming deficiency payments, the amount disbursed in this final payment will amount to approximately £1,207,900.

This will bring the total deficiency payments for the year, including the advance payments made in February and June, 1938, to approximately £1,933,000, or an average of just over £25 per grower. The deficiency payments for 1937-38 are

at a rate of 1s. 7*d*. per cwt. (equal to 7*s*. 1½*d*. per quarter) in respect of all sales of wheat credited to growers for that year in accordance with valid wheat certificates delivered to the Wheat Commission.

Approximately 24,417,000 cwt. of millable wheat were sold by the 76,649 growers who have qualified for deficiency payments, and 165,375 certificates relating to sales of this wheat were delivered to the Wheat Commission.

Livestock Industry Act, 1937: *Approval Orders under Section* 14. The Livestock Commission, with the approval of the Minister, have recently made two further Orders under Section 14 of the Act, approving premises known as The Station Mart, at Northallerton, Yorks, N.R., and the Haywards Heath Market, at Haywards Heath, Sussex, respectively, for use as livestock markets. Both markets have recently been extended to include premises that were not used for the purposes of a livestock market during the year ended November 30, 1936. The new premises at Haywards Heath Market are in lieu of a part of the old premises which, owing to the termination of lease, have had to be vacated.

Livestock Advisory Committee. The Minister of Agriculture and Fisheries, the Secretary of State for Scotland and the Secretary of State for the Home Department, have appointed Mr. D. W. Pentland a representative member of the Livestock Advisory Committee.

Potato Marketing Scheme : *Riddle Regulations* New riddle regulations, to take the place of those made earlier in the month and to come into operation forthwith throughout Great Britain, were announced by the Potato Marketing Board on August 25. The new regulations fix minimum riddles of 2 in. for Kerr's Pink and Redskin,* 1⅞ in for Epicure and Arran Banner, 1⅝ in for King Edward, Red King, Golden Wonder and Gladstone and 1¾ in. for all other varieties.

Sale of "Seconds." The Board also announced an alteration in the definition of " seconds " Until further notice " seconds " are now defined as sound, marketable potatoes which are capable of passing through a riddle of 1⅞ in or less but stand on a riddle of 1¼ in. Subject to the use of special labels, obtainable from the Board, " seconds " may now be marketed by any registered producer in Great Britain

National Mark Publicity. At the Birmingham and Midland Grocers' and Food Trades' Exhibition (Bingley Hall) October 4–13, and the North London Exhibition (Alexandra Palace) October 12–29, a comprehensive range of the products packed and graded to National Mark standards will be displayed, together with a working demonstration of the testing, grading and packing of eggs, while at the Imperial Fruit Show (Coliseum, Bristol) October 28–November 5, in addition to a display of National Mark produce, a demonstration of the packing and grading of apples will be staged.

* Operative only to September 14, when riddle was reduced to 1¾ in. for Kerr's Pink and Redskin.

AGRICULTURAL RETURNS OF ENGLAND AND WALES, 1938

Numbers of Live Stock, Poultry and Agricultural Workers

The following tables give *revised* preliminary figures of the numbers of live stock and poultry and the numbers of agricultural workers on holdings above one acre in extent in England and Wales on June 4, 1938, and should be substituted for the figures given on pp 617–621 of the preliminary statement appearing in the September, 1938, issue of this JOURNAL.

Final figures will be published in 1939 in *Agricultural Statistics*, 1938, *Part I*, and meanwhile the provisional county totals of various descriptions of crops, live stock, poultry and agricultural workers are being published at intervals in the Ministry's *Agricultural Market Report*.

Live Stock

	1938	1937	Increase		Decrease	
	No	*o*	*No*	*Per cent*	*No.*	*Per cent.*
Cows and Heifers in milk .	2,234,800	2,217,400	17,400	0·8	—	—
Cows in Calf, but not in milk	374,600	394,400	—	—	19,800	5·0
Heifers in Calf	462,100	456,100	6,000	1·3	—	—
Other Cattle:						
Under one year	1,365,300	1,265,400	99,900	7·9	—	—
One year and under two	1,289,200	1,274,400	14,800	1·2	—	—
Two years and above ..	982,400	1,011,500	—	—	29,100	2·9
TOTAL OF CATTLE .	6,708,400	6,619,200	89,200	1·3	—	—
Ewes kept for Breeding* ..	8,527,400	7,320,500	1,206,900	16·5	—	—
Other Sheep						
One year and above ..	1,528,100	1,486,700	41,400	2·8	—	—
Under one year .	7,845,200	8,387,000	—	—	541,800	6·5
TOTAL OF SHEEP .	17,900,700	17,194,200	706,500	4·1	—	—
Sows kept for Breeding ..	433,200	455,400	—	—	22,200	4·9
Other Pigs						
Over two months ..	2,243,700	2,140,500	103,200	4·8	—	—
Under two months ..	884,200	1,039,100	—	—	154,900	14·9
TOTAL OF PIGS ..	3,561,100	3,635,000	—	—	73,900	2·0
Horses used for Agricultural purposes (including Mares for Breeding)	561,600	554,800	6,800	1·2	—	—
Unbroken Horses (including Stallions):						
One year and above ..	107,100	101,000	6,100	6·0	—	—
Under one year	52,800	53,700	—	—	900	1·7
Other Horses	134,100	149,200	—	—	15,100	10·1
TOTAL OF HORSES ..	855,600	858,700	—	—	3,100	0·4

* Includes 1,510,300 two-tooth ewes in 1938 not separately distinguished in 1937, some of which were included last year among " other sheep."

Poultry

	1938	1937	Increase		Decrease	
	No. Thous	*No. Thous.*	*No Thous.*	*Per cent.*	*No. Thous.*	*Per cent.*
Fowls:						
Over 6 months old ..	22,912	24,377	—	—	1,465	6·0
Under 6 months old ..	29,527	28,256	1,271	4·5	—	—
TOTAL	52,439	52,633	—	—	194	0·4
Ducks	2,334	2,285	49	2·1	—	—
Geese	607	553	54	9·8	—	—
Turkeys	788	680	108	15·9	—	—

Agricultural Workers

	1938	1937	Increase		Decrease	
	No	*No*	*No*	*Per cent*	*No*	*Per cent.*
Regular Male Workers .						
21 years old and over .	381,200	395,200	—	—	14,000	3·5
Under 21 years old ..	90,100	94,600	—	—	4,500	4·8
TOTAL	471,300	489,800	—	—	18,500	3·8
Casual Male Workers ..						
21 years old and over ..	47,800	58,000	—	—	10,200	17·6
Under 21 years old ..	6,300	7,300	—	—	1,000	13·7
TOTAL	54,100	65,300	—	—	11,200	17·2
TOTAL MALE WORKERS, REGULAR AND CASUAL..	525,400	555,100	—	—	29,700	5·4
Women and Girls:						
Regular Workers ..	41,400	46,200	—	—	4,800	10·4
Casual Workers ..	25,500	30,400	—	—	4,900	16·1
TOTAL	66,900	76,600	—	—	9,700	12·7
TOTAL WORKERS, ALL CLASSES	592,300	631,700	—	—	39,400	6·2

ACREAGE OF HOPS

PRELIMINARY STATEMENT COMPILED FROM THE RETURNS COLLECTED ON JUNE 4, 1938, SHOWING THE ACREAGE UNDER HOPS IN EACH COUNTY OF ENGLAND IN WHICH HOPS WERE GROWN, WITH A COMPARATIVE STATEMENT FOR THE YEARS 1937 AND 1936

Counties, etc.	1938	1937	1936
KENT — East	2,010	1,864	1,990
KENT — Mid	3,140	3,092	3,032
KENT — Weald	5,080	4,961	5,084
TOTAL, Kent	10,230	9,917	10,106
HANTS.	600	559	556
HEREFORD	4,100	4,039	3,994
SURREY	80	112	115
SUSSEX	1,630	1,582	1,586
WORCESTER	1,760	1,818	1,894
OTHER COUNTIES	90	66	66
TOTAL	18,490	18,093*	18,317*

* These figures include the acreage left unpicked which was estimated in 1937 to be 31 acres and in 1936 about 1,122 acres

FARM WORKERS' MINIMUM RATES OF WAGES

Enforcement of Minimum Rates—During the month ending September 9, 1938, legal proceedings were taken against six employers for failure to pay the minimum rates of wages fixed by the Orders of the Agricultural Wages Board Particulars of the cases follow :—

Committee Area	Court	Fines Imposed	Costs Allowed	Arrears of Wages ordered	No. of workers involved
		£ s. d	£ s d.	£ s d.	
Bedford	Ampthill	0 10 0	1 16 0	35 0 0	1
Cardigan	Talybont	1 0 0	—	16 16 9½	1
Devon	Tavistock	(a)	1 0 0	8 13 6	1
Glamorgan	Merthyr	3 0 0	—	22 10 0	4*
Northumberland	Berwick-on-Tweed	(a)	2 4 6	22 10 0	3
Northumberland	Berwick-on-Tweed	(a)	1 19 6	20 19 0	3
	Totals	£4 10 0	7 0 0	126 9 3½	13

(a) Dismissed on payment of Costs.
* Case of 1 worker dismissed.

WIRELESS TALKS, OCTOBER, 1938

Station and Date	*Time p m*	*Speakers*	*Subject*
NATIONAL ·			
Oct 6	6.20	Mr F Rayns	Farming To-day An American Farming Tour
,, 13	6.20	Mr F Rayns	Farming To-day . Seasonal Talk—After the Harvest at Sprowston
,, 20	6.20	Messrs F Rayns and F. Hanley	Farming To-day Soil Analyses and the Farmer.
,, 27	6.20	Mr F Rayns and Lord William Percy	Farming To-day . Experiences in Bacon Pig Production
REGIONAL			
Oct 8	2.40	Messrs H J Barnes and R Gamble	Bee-keeping
MIDLAND			
Oct 1	7.00	Mr Syd Carter	Commentary on Ploughing Competition at Moreton-in-the-Marsh
,, 4	8.30	Miss Helen Molyneux and Mr W B Thompson with farmers	Poultry Breeding (First Meeting of monthly Midland Farmer's Club)
,, 20	—	Mr W B Thompson	Winter Ploughing and Maturing
WEST			
Oct 10	6.40	—	On the Job I —The Farm
,, 12	7.30	The Rt Hon W S Morrison and Mr Anthony Hurd	The Use of the Land I — Eleven talks and discussions on the organization of the agricultural industry
,, 13	6.40	-	For Western Farmers in Particular
,, 17	6.40		For Young Farmers
,, 19	7.30	-	The Use of the Land —II
,, 26	7.30		The Use of the Land --III
,, 27	6.40		For Western Farmers
WELSH			
Oct 7	7.30	Messrs E Verley Merchant, T Evans and H Bennet	A Debate on the Milk Marketing Act (In Welsh)
,, 14	7.30	Dr T J Jenkins	The Grass Lands of Wales Grass Breeding (In Welsh)
,, 21	7.30	Mr R D Williams	Clover Breeding (In Welsh)
,, 28	7.30	Mr Gwilym Evans	Seed Production in Wales (In Welsh)
NORTH .			
Oct 6	6.40	Mr W B Mercer	A Survey of Farming in the North-west in 1938
,, 20	—	Mr James Strachan	A Review of the Year Eastern part of the North Region.

PRICES OF ARTIFICIAL MANURES

Description		Average prices per ton (2,240 lb) during week ended Sept 14				
		Bristol	Hull	L'pool	London	Costs per Unit ¶
		£ s	£ s	£ s	£ s	s d
Nitrate of Soda (N 15½%) ..	*	8 0c	8 0c	8 0c	8 0c	10 4
,, ,, Granulated (N 16%)	*	8 0c	8 0c	8 0c	8 0c	10 0
Nitrate of Lime (N 13%) ..	*	7 7e	7 7e	7 7e	7 7e	11 4
Nitro-Chalk (N 15½%) .. .	*	7 10c	7 10c	7 10c	7 10c	9 9
Sulphate of Ammonia — Neutral (N 20·6%) .. .	*	7 5c	7 5c	7 5c	7 5c	7 0
Calcium Cyanamide (N 20·6%)	*	7 10d	7 10d	7 10d	7 10d	7 3
Kainite (Pot 14%) . ..	§	2 18	2 15	2 15	2 15	3 11
Potash Salts (Pot 30%) ..	§	5 0	5 1	5 0	4 17	3 3
,, ,, (Pot 20%) .	§	3 15	3 12	3 12	3 12	3 7
Muriate of Potash (Pot 50%)	§	8 3	8 8	8 5	8 1	3 3
Sulphate ,, ,, (Pot 48%)	§	9 13	10 0	9 17	9 11	4 0
Basic Slag (P A 15½%) .	§	2 12b	2 5b	—	2 10b	3 2
,, ,, (P A 14%) . ..	§	2 8b	2 0b	2 0b	2 6b	3 3
Grd Rock Phosphate (P A 26–27½%)	§	3 4a	3 0a	2 15a	2 10a	1 10
Superphosphate (S P A 16%)	§	3 4	—	3 2f	2 19g	3 9
,, (S P A 13¾%)	§	3 1	2 17	2 19f	2 16g	4 1
Bone Meal (N 3½%, P A 20½%)	§	—	7 5	7 0h	6 17	—
Steamed Bone Flour (N ¾%, P A 27½–29½%) . ..	§	—	4 15	4 7h	4 10	—

Abbreviations N = Nitrogen, P A = Phosphoric Acid, S P A = Soluble Phosphoric Acid, Pot = Potash

* Prices are for not less than 6-ton lots, at purchaser's nearest railway station, unless otherwise stated Unit values are calculated on carriage-paid prices

§ Prices are for not less than 2-ton lots, nett cash for prompt delivery, f o r, in town named, unless otherwise stated Unit values are calculated on f o r prices

a Prices for 4-ton lots f o r Fineness 85% through standard sieve

b Prices for 6-ton lots Prices at Bristol are f o r Bridgwater, at Hull and Liverpool f o r neighbouring works and at London f o r at depots in London districts Fineness 80% through standard sieve

c For lots of 4 tons and under 6 tons the price is 1*s* per ton extra, for lots of 2 tons and under 4 tons, 5*s* per ton extra, for lots of 1 ton and under 2 tons, 10*s* extra and for lots of 2 cwt and under 1 ton, 20*s* extra

d Delivered in 5-ton lots at purchaser's nearest railway station For lots of 2 tons and under 5 tons the price is 5*s* per ton extra, for lots of 1 ton and under 2 tons, 10*s* per ton extra and for lots of 4 cwt and under 1 ton, 20*s* extra

e For lots of 4 tons and under 6 tons the price is 1*s* per ton extra, for lots of 2 tons and under 4 tons, 5*s*. per ton extra, for lots of 1 ton and under 2 tons 7*s* 6*d* per ton extra and for lots of under 1 ton, 20*s* extra

f Prices shown are f o r Widnes

g Prices shown are ex works London, f o r southern rails, 1*s* 3*d* extra

h Prices shown are f o r Appley Bridge

¶ *These are calculated by regarding a ton as comprising* 100 "*units*" (*equal parts of* 22·4 *lb*) *so that a fertilizer, for example, with* 16 *per cent nitrogen contains* 16 *such "units" in a ton Then, if the price per ton of such a fertilizer be divided by the percentage figure, the deduced cost is that of a "unit" of that agent. Those in the table above are based on London prices (For further explanation, see Advisory Leaflet, No* 146, "*The Valuation of Artificial Manures,*" *obtainable from the Ministry, free of charge*)

PRICES OF FEEDING STUFFS

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv	Protein equiv.
	£ s	£ s	£ s.		s. d.	d	%
Wheat, British ..	4 15‖	0 8	4 7	72	1 2	0·62	9·6
Barley, Canadian No 3 Western ..	5 18	0 8	5 10	71	1 7	0·85	6·2
„ American ..	6 0†	0 8	5 12	71	1 7	0·85	6·2
„ Persian ..	5 13*	0 8	5 5	71	1 6	0·80	6·2
„ Russian ..	5 18	0 8	5 10	71	1 7	0·85	6·2
Oats, English, white ..	6 7‖	0 9	5 18	60	2 0	1·07	7·6
„ „ black and grey	6 7‖	0 9	5 18	60	2 0	1·07	7·6
„ Scotch, white ..	10 0	0 9	9 11	60	3 2	1·70	7·6
„ Canadian— No. 2 Western	9 15*	0 9	9 6	60	3 1	1·65	7·6
No. 1 feed ..	7 7§	0 9	6 18	60	2 4	1·25	7·6
mixed feed ..	6 2	0 9	5 13	60	1 11	1·03	7·6
„ Argentine .	7 13	0 9	7 4	60	2 5	1·29	7·6
Maize, American ..	6 7	0 7	6 0	78	1 6	0·80	7·6
„ Argentine ..	6 13	0 7	6 6	78	1 7	0·85	7·6
„ Danubian Gal. Fox.	6 5§	0 7	5 18	78	1 6	0·80	7·6
Peas, Japanese .	18 10†	0 15	17 15	69	5 2	2·77	18·1
Dari	8 0†	0 8	7 12	74	2 1	1·12	7·2
Milling Offals—							
Bran, British ..	6 2	0 16	5 6	43	2 6	1·34	9·9
„ Broad ..	6 7	0 16	5 11	43	2 7	1·38	10·0
Middlings, fine, imported	7 2	0 13	6 9	69	1 10	0·98	12·1
Weatings‡	6 17	0 14	6 3	56	2 2	1·16	10·7
„ Superfine‡	7 5	0 13	6 12	69	1 11	1·03	12·1
Pollards, imported ..	6 15	0 14	6 1	50	2 5	1·29	11·0
Meal, barley	7 2	0 8	6 14	71	1 11	1·03	6·2
„ „ grade II	6 7	0 8	5 19	71	1 8	0·89	6·2
„ maize . ..	6 12	0 7	6 5	78	1 7	0·85	7·6
„ „ South African	6 5§	0 7	5 18	78	1 6	0·80	7·6
„ „ germ .	6 12	0 11	6 1	84	1 5	0·76	10·3
„ locust bean ..	7 15	0 5	7 10	71	2 1	1·12	3·6
„ bean .. .	9 10	0 17	8 13	66	2 7	1·38	19·7
„ fish (white) ..	15 0	2 4	12 16	59	4 4	2·32	53·0
„ Soya bean (extracted)‡	8 15	1 10	7 5	64	2 3	1·21	38·3
Maize, cooked, flaked	7 10	0 7	7 3	84	1 8	0·89	9·2
„ gluten feed ..	6 17	0 13	6 4	76	1 8	0·89	19·2
Linseed cake—							
English, 12% oil .	9 17	1 0	8 17	74	2 5	1·29	24·6
„ 9% „ ..	9 5	1 0	8 5	74	2 3	1·21	24·6
„ 8% „ .	9 0	1 0	8 0	74	2 2	1·16	24·6
Cottonseed cake, English, Egyptian seed, 4½% oil ..	5 15	0 18	4 17	42	2 4	1·25	17·3

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s	£ s	£ s		s d.	d.	%
Cottonseed cake, Egyptian, 4½% oil ..	5 5	0 18	4 7	42	2 1	1·12	17·3
Cottonseed cake, decorticated, 7-8% oil	7 10†	1 8	6 2	68	1 10	0·98	34·7
Cottonseed meal, decorticated, 7-8% oil	7 10†	1 8	6 2	70	1 9	0·94	36·8
Coconut cake, 5% oil	7 10†	0 18	6 12	77	1 9	0·94	16 4
Ground nut cake, decorticated, 6-7% oil	8 7*	1 8	6 19	73	1 11	1·03	41·3
Ground nut cake, imported decorticated, 6-7% oil .	7 2	1 8	5 14	73	1 7	0·85	41·3
Palm-kernel cake, 4½-5½% oil	7 10†	0 12	6 18	73	1 11	1·03	16·9
Palm-kernel cake meal, 5½% oil	7 12†	0 12	7 0	73	1 11	1·03	16·9
Palm-kernel meal, 1-2% oil ..	7 2	0 12	6 10	71	1 10	0·98	16·5
Feeding treacle .	5 0	0 8	4 12	51	1 10	0·98	2·7
Brewers' grains, dried ale	6 0	0 11	5 9	48	2 3	1·21	12·5
Brewers' grains, dried porter	5 12	0 11	5 1	48	2 1	1·12	12·5

* At Bristol. § At Hull † At Liverpool

‡ In these instances manurial value, starch equivalent and protein equivalent are provisional

|| New Crop

NOTE The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of August, 1938, and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative values of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, if linseed cake is offered locally at £11 per ton, then since its manurial value is £1 per ton as shown above, the cost of food value per ton is £10. Dividing this figure by 74, the starch equivalent of linseed cake as given in the table, the cost per unit of starch equivalent is 2*s*. 8*d*. Dividing this again by 22·4, the number of pounds of starch equivalent in one unit, the cost per lb of starch equivalent is 1·43*d*. Similar calculations will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own markets. The figures given in the table under the heading "manurial value per ton" are calculated on the basis of the following unit prices: N., 7*s*. 2*d*.; P_2O_5, 2*s*. 6*d*.; K_2O, 3*s*. 6*d*.

FARM VALUES OF FEEDING STUFFS

The prices in respect of the feeding stuffs used as bases of comparison for the purpose of this month's calculations are as follow —

	Starch equivalent Per cent	*Protein equivalent Per cent.*	*Per ton* £ s
Barley (imported)	71	6·2	5 17
Maize	78	7·6	6 13
Decorticated ground nut cake ..	73	41·3	7 14
,, cotton-seed cake	68	34·7	7 10

(Add 10*s* per ton, in each instance, for carriage)

The Table below is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices (The "food values" which it is recommended should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows, are given in the November, 1936, issue of the Ministry's Journal, p 816)

FARM VALUES

Crop	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent	Per cent	£ s
Wheat . .	72	9·6	6 14
Oats .	60	7 6	5 11
Barley .	71	6 2	6 8
Potatoes . .	18	0 8	1 12
Swedes . .	7	0 7	0 13
Mangolds .	7	0·4	0 12
Beans .	66	19 7	6 14
Good meadow hay	37	4 6	3 8
Good oat straw .	20	0 9	1 15
Good clover hay .	38	7 0	3 13
Vetch and oat silage	13	1 6	1 4
Barley straw .	23	0·7	2 0
Wheat straw	13	0 1	1 2
Bean straw	23	1·7	2 1

FOOT-AND-MOUTH DISEASE

Four outbreaks of foot-and-mouth disease were confirmed during the period August 21 to September 20 inclusive of which one, viz , at Glan Conway, Denbigh, on August 24, was in an existing Infected Area This Area was released from restrictions on September 15.

Outbreaks which were confirmed at Worplesdon, Surrey, on August 28, and at Woolhope, Hereford, on September 1, necessitated the imposition of "Infected Area" restrictions on areas extending approximately 15 miles around each of the Infected Places The counties affected were Surrey, Berkshire, Buckinghamshire, Hampshire, Middlesex and West Sussex , and Hereford, Gloucester, Worcester and Monmouth respectively. A further outbreak was confirmed at Fownhope, Hereford, on September 5.

The Area around Worplesdon, Surrey, was released from restrictions on September 19 and that around Woolhope, Hereford, was contracted to one of approximately 5 miles radius on September 20 If no further outbreaks are confirmed in the meantime, the latter Area will be released from restrictions on September 27

APPOINTMENTS

COUNTY AGRICULTURAL EDUCATION STAFF: ENGLAND

Staffordshire: Mr. J. W. Rowland, N.D.P, C D.P., has been appointed Assistant Poultry Lecturer and Adviser.

Durham: Mr. W. M. Ashton, B.Sc., Ph.D, has been appointed Chemist, and Mr. J A. Oliver, B Sc (Agric.), Biologist, at the School of Agriculture, Houghall

Essex: Mr R. A Engledow, N D H., R.H.S., has been appointed Assistant Lecturer in Horticulture *vice* Mr. H Fraser, N D.H, F R H.S

WALES.

Monmouthshire: Mr E. K Griffiths, M Sc, N.D.D., has been appointed Senior Lecturer in Agriculture *vice* Mr. E. David, B Sc., resigned.

Mr W E. Morgan has been appointed Assistant Poultry Instructor *vice* Mr R. F Hall, N.D.P, promoted to County Poultry Adviser.

Miss J E. Luck, Dip Dom Sci., has been appointed Assistant Instructress in Rural Domestic Economy *vice* Miss M A Price, B Sc., resigned

SOME ADDITIONS TO THE LIBRARY

Agriculture, General and Miscellaneous

Orwin, C S, and C S—The Open Fields (xii + 332 pp + 29 plates + 7 maps) Oxford at the Clarendon Press, 1938, 21*s*

Paterson, J W—Science in Agriculture. (viii + 288 pp) London. Longmans, Green & Co., 1938, 6*s* 6*d*

The Land Utilisation Survey of Britain. Part 69—Lincolnshire (Parts of Holland) *G I Smith* (83 pp),1937, 2*s* 6*d*

Part 79—Middlesex and the London Region. *E C Willatts*. (pp 117–304), 1937, 4*s*

Part 86—Somerset *T Stuart-Menteath*. (141 pp + 1 map) 1938, 4*s* London School of Economics.

Imperial Economic Committee—Apples and Pears. A Survey of Production and Trade in the British Empire and Foreign Countries (275 pp) London H M Stationery Office, 1938, 4*s*

Industrial Fibres A Summary of Figures of Production, Trade and Consumption relating to Cotton, Wool, Mohair, Silk, Flax, Jute, Hemp and Rayon (113 pp) London H M Stationery Office, 1938, 2*s* 6*d*

United States Department of Agriculture—Farmers' Bulletin No 1801. —Making Lime on the Farm (20 pp) Washington, 1938.

League of Nations Economic Committee Preliminary Investigation into Measures of a National or International Character for Raising the Standard of Living Memorandum prepared by *N F Hall* (91 pp) Geneva 1938.

European Conference on Rural Life Report of the Preparatory Committee on the Work of its First Session (April 4th to 7th, 1938) (9 pp) Geneva, 1938, 6*d*.

Agricultural Economics

Oxford Agricultural Economics Research Institute.—The Distribution of Milk, a Study of Town Delivery Costs by *J Cripps* (91 pp.) Oxford: 1938, 2*s*. 6*d*.

Seale-Hayne Agricultural College, Newton Abbot.—Department of Economics.—Farmers' Report No. 15—A Further Economic Study of Pig Enterprises on Devon and Cornwall Farms, 1937, by *S. T. Morris*. (34 pp mimeo), 1938.

Agricultural Machinery

Culpin, C.—Farm Machinery. (405 pp.) London: Crosby Lockwood & Son, 1938, 18*s*.

United States Department of Agriculture.—Circular No. 470:—Performance Characteristics of 5- and 6-foot Combines. (36 pp.) Washington, 1938

Food, Nutrition and Preservation

Woodcock, F. H., and Lewis, W. R.—Canned Foods and the Canning Industry. (x + 119 pp.) London: Pitman, 1938, 7*s*. 6*d*

The National Institute for Research in Dairying (University of Reading).—Milk and Nutrition. New Experiments reported to the Milk Nutrition Committee. Part II. The Effects of Dietary Supplements of Pasteurised and Raw Milk on the Growth and Health of School Children (Interim Report). (34 pp.) Reading, 1938, 1*s*. 9*d*.

United States Department of Agriculture.—Circular No. 73—The Cold Storage of Eggs and Poultry. (51 pp) Washington (revised), 1938.

Circular No. 278:—The Commercial Storage of Fruits, Vegetables and Florists' Stocks. (43 pp.) Washington (revised), 1938.

Horticulture and Botany

Ellis, C, and Swaney, M. W—Soilless Growth of Plants, Use of Nutrient Solutions, Water, Sand, Cinders, etc (155 pp and 1 plate) New York Reinhold Publishing Corporation, London: Chapman & Hall, 1938, 13*s*. 6*d*.

Shewell-Cooper, W. E.—Modern Flower-growing for Profit. (2nd Edition) (215 pp.) London. Ernest Benn, 1938, 5*s*

Cook, L. J.—Perpetual Carnations (2nd Edition) (102 pp. + 19 plates) London: Ernest Benn, 1938, 3*s*. 6*d*

Fourth International Grassland Congress—Synopsis of the Chief Experiments at the Welsh Plant Breeding Station and at the Cahn Hill Improvement Scheme. (70 pp) Aberystwyth University College of Wales, 1937.

Live Stock, including Poultry

Jull, M. A—Poultry Husbandry. (2nd Edition) (viii + 548 pp) New York and London: McGraw-Hill Publishing Co, 1938, 24*s*

Pearce-Gervis, L.—Complete Poultry Keeper and Farmer (320 pp. + 48 plates.) London: Cassell, 1938, 10*s*. 6*d*.

Swepstone, H. E.—Laying Battery Management (2nd Edition) (48 pp) London *The Feathered World*, 1938, 1*s*.

MacEwan, J. W G, and Ewen, A. H.—The Science and Practice of Canadian Animal Husbandry. (xiv + 462 pp) Toronto Thomas Nelson & Co, 1936, 12*s*. 6*d*.

United States Department of Agriculture.—Farmers' Bulletin No 1470—Care and Management of Dairy Cows. (40 pp) Washington (revised), 1938.

Plant Diseases and Pests

Laidlaw, P. P.—Virus Diseases and Viruses. (52 pp.) Cambridge University Press, 1938, 2*s*. 6*d*.

Soils

Sigmond, A. A. J. de.—The Principles of Soil Science. (xiv + 362 pp. + 4 plates) London: Thomas Murby & Co., 1938, 22*s*. 6*d*.

Reifenberg, A, and Whittles, C. H—The Soils of Palestine: Studies in Soil Formation and Land Utilisation in the Mediterranean. (viii & 131 pp. + 8 plates.) London: Thomas Murby, 1938, 14*s*.

NOTICES OF BOOKS

Veterinary Science

Hutyre, F., Marek, J., and Manninger, R.—Special Pathology and Therapeutics of the Diseases of Domestic Animals. Fourth English Edition edited by *J. R. Greig, J. R. Mohler and A. Eichhorn* Vol I. (xvi + 962 pp. + 16 plates) Vol. II. (xi + 704 pp.) Vol. III (xi + 763 pp. + 7 plates.) London: Baillière, Tindall & Cox, 1938, 6 guineas.

NOTICES OF BOOKS

The Structure and Composition of Foods. Vol. III. By A. L. and K. B. Winton, Ph.D. Pp. xviii+524 (London: Chapman & Hall, Ltd 1938 Price 40*s*. net.)

This volume is the third of a series dealing comprehensively with the composition and chemical characteristics of the manifold foods that make up the varied dietaries of men and animals. The first volume dealt with the cereals, starch, oil seeds, nuts, oils and forage plants. In the second volume a detailed treatment of vegetables, legumes and fruits was given. Favourable notices of both these volumes were published in this *Journal* at the time of their appearance. The present volume is devoted exclusively to foods of animal origin, and includes a systematic account of the chemical aspects of cow's milk and the milk of other species, butter, cheese, ice cream, eggs, meat, meat extracts, gelatin, animal fats, poultry, fish and shell fish. The fourth and final volume, which will deal with sugar, syrup, tea, coffee, cocoa, spices, extracts, etc., is in the course of preparation.

Readers who are familiar with the two volumes previously published will be convinced already of the extreme usefulness of this series. The treatment of the subject matter in the third volume follows the general plan adopted in the earlier issues, and it need only be pointed out that the influence of the various factors of production and manufacture on the composition of the food products, as well as the questions of the constitution and properties of the individual components of the various foods, have been given special attention. The series as a whole is intended to furnish a complete chemical survey of all the numerous foods and food products that comprise the dietary of man and his domestic animals.

It should perhaps be made clear that these volumes are scarcely intended for the non-scientific reader, but rather should be regarded as works of reference for the student, teacher, research worker and agricultural adviser.

Animal Nutrition. By L. A. Maynard. Pp. xiv + 483 and 36 figures. (London · McGraw-Hill Publishing Company, Ltd. 1938. Price 24*s*.)

This is essentially a text-book for the scientific student of nutrition Indeed, the primary purpose of the author was to prepare a handbook that might be used by members of his own classes, and the material presented has been selected as a result of some twenty years' experience in teaching the foundations of nutritional science to graduate and undergraduate students at Cornell University. A knowledge of physiology and biochemistry is essential if the reader is to derive the fullest advantage from a study of this book, which, in a broad sense, may be described as "Armsby brought up to date."

The volume begins with a philosophical survey of what the author terms the "expanding field of nutrition." The field of nutrition is constantly expanding because each path that is opened up reveals new ones to be

explored. Crude studies of mineral requirements, for example, have led to the discovery that numerous "trace elements," such as copper, manganese, zinc and even cobalt have, no less than calcium, phosphorus and chlorine, essential rôles to play in the vital reactions of the body. Each particular vitamin, which at one time was thought to be a single nutritive factor, is proving to consist of several factors differing as regards their distribution in foods and their physiological effects. As higher and higher productive performance is sought in our farm animals, the more we recognize the limitations of our measures of adequate nutrition and the more do new problems press upon us for solution. Chemistry, physiology, botany, pathology, physics and even mathematics—all are called in to serve the purposes of the nutritional scientist in his efforts to elucidate the principles of the subject, and so point the way to greater efficiency and economy in the feeding of man's domestic animals.

This opening chapter furnishes the keynote to the whole volume, which will receive a sincere welcome from student, teacher and research worker alike. The reader is led along sober paths to the most recent discoveries in the domains of vitamins, the metabolism of protein, carbohydrate, fat, energy and minerals and the nutritional factors affecting growth, lactation, reproduction and the performance of muscular work. The treatment is sufficiently detailed to satisfy the most exacting student of the subject; the style is pleasant and lucid. It is a treatise that should speedily find its way on to the shelves of every agricultural and biochemical library.

The Feeding of Farm Live Stock. By J. C. B Ellis, M.A Pp 291+26. Illustrated. (London· Crosby Lockwood & Son, Ltd 1938. Price 15*s*.)

When reviewing text books on animal nutrition, it is all too frequently necessary to end the notice with the warning that the volume in question is intended for the scientific student rather than the practical man The present work, however, is an exception to this rule, for Mr Ellis has succeeded in writing a book that should make as wide an appeal among enlightened farmers as among the teachers and students of the subject. This has been rendered possible by the manner in which the author has stressed the practical rather than the biochemical and physiological aspects of nutritional science

The main object of the book is to explain how rations for live stock may be computed on the basis of starch equivalents and protein equivalents. The early chapters are devoted to a clear and straightforward explanation of the conceptions of net energy and starch equivalent, including a simple description of the methods whereby the feeding standards for different classes of farm animals have been established This is followed by a useful chapter illustrating the method of computing rations on the basis of these standards for the winter feeding of dairy cows, fattening bullocks and calves.

The middle section is given over to a description of the various classes of feeding stuffs—their composition, feeding value and special usages. The up-to-date character of the book is made evident by the adequate attention paid to such modern processes as grass-drying and the making of A.I.V and molassed silage, together with valuable information as to how the products from these processes should be employed in the winter feeding of live stock. In the later chapters the author has set out to show to what extent the system of rationing described in the earlier section may be applied to the feeding of cattle, sheep, pigs, horses and poultry. In doing this he has blended science with practice in a skilful and pleasant manner.

Not the least attractive feature of the book are the excellent illustrations that contribute very considerably to the intelligent appreciation of the subject-matter. Mr. Ellis is to be congratulated on having written a text book that should prove helpful to all who are interested, from whatever angle, in the application of sound principles to the feeding of farm animals.

Economics of Co-operative Marketing. By H. H. Bakken, M.A., and M. A. Schaars, Ph D. Pp. viii+583. (London: McGraw-Hill Publishing Co, Ltd., Aldwych House. 1937. Price 24s.)

The authors of this work are members of the faculty of Agricultural Economics at the University of Wisconsin, and they have made an exhaustive study of co-operation. Co-operative buying, as well as selling, comes within the scope of the book, and the consumer's co-operative movement receives attention; but the authors explain that farmers' co-operative sales associations cover 85 per cent of the co-operative business of the United States, and the book accordingly deals in the main with this form of co-operative enterprise

The text is divided into five parts. Part I surveys the early growth of co-operative trading and its gradual evolution to modern forms.

Part II treats of the principles and tenets of co-operative marketing, with particular reference to the experience of the United States. An especially valuable chapter reviews the conditions necessary for the success, and the reasons for the failure, of co-operative associations

Part III gives a detailed explanation of the relationship between co-operative associations and Federal and State law in the United States, and the attitude of the Courts is also reviewed; and this part concludes with a chapter on the system of contracts with members which is widely adopted by co-operative associations in the United States.

Part IV deals with the problems and the value of efficient management, the need for a sound financial system and the actual methods of financing co-operatives, and the advantages of pooling the produce supplied by members and the receipts from sales. The various methods in use of marketing produce are reviewed, and consideration is given to the extent to which co-operative bodies are able to control the quantity and influence the quality of the crops produced by their members.

Part V is devoted to a thoughtful and interesting study of the limitations and possibilities of co-operation. The authors stress the relative youthfulness of the co-operative movement and, while realizing that the march of progress may well affect co-operative organization and practice, and that it is Utopian to expect co-operation to oust individualism completely, they are of opinion that the movement has brought, and will continue to bring, great benefits to agriculture.

The study of this work should amply repay all who are interested in agricultural co-operation. Although it draws largely upon the experience of the United States, the conclusions that are reached are of value to those in other countries. It may be added that the lay-out of the work is excellent.

Milk Marketing Before and After Organization. By B. L. Smith and H. Whitby. Pp. 56. (Oxford: Agricultural Economics Research Institute. 1937. Price 2s. net.)

This book provides a useful record of the changes which have taken place as a result of the operations of the Milk Marketing Scheme, in the production and marketing of milk in a particular area. An intensive study of the economics of milk production in central Somerset was made by the Agricultural Economics Research Institute in 1931–32, and comparable data were obtained for the same area in 1934–35. Full information

and statistics are given regarding the production, marketing and utilization of milk in the area, and the prices obtained for milk and farm-produced milk products. An outstanding feature which is brought out by the report is the swing-over of Caerphilly cheese manufacture in the area from farmhouse to factory production, a change which has been almost complete during the three years between the two surveys.

Problems in Agricultural Marketing. By D. W. Malott. Pp. xxiii+410. (London: McGraw-Hill Publishing Co., Ltd. 1938. Price 18s.)

This appears as one of a series known as The Harvard Problem Books, and has been prepared according to the author, who is Associate Professor of Business in Harvard University, with the object of presenting concrete material for analysing the problems of agricultural marketing.

The material is arranged under 12 section headings, each section dealing with from three to eight problems. The problems thus set out are independent of each other in that each is presented for solution on its own merits from the information given, the grouping being merely for convenience and orderly presentation. The book as a whole embraces problems concerning the individual—not only the producer, but also the middle man and the processor; problems arising out of co-operative marketing and co-operative advertising; problems relating to auction markets, futures exchanges and central markets; problems of finance, storage and transport, and national problems of agricultural policy.

"Problems in Agricultural Marketing" may best be described as a case book dealing with 53 topical cases. It gives a number of cross-section views of present-day conditions governing American agricultural marketing and administration. But since it merely states the problems without discussion and focuses these in two questions at the end of each case without attempting to supply the answers, the reader, especially if he does not have a background knowledge of American agriculture and marketing methods, may have difficulty in distinguishing the wood from the trees. The book is nevertheless thought-provoking, and should prove a useful adjunct to other publications for those engaged in studying agricultural economics and marketing, particularly from the American point of view.

Agricultural Analysis. A Handbook of Methods excluding those for Soils. By C H. Wright, M.A., F.I.C. Pp. 343 and 8 figs. (London: Thomas Murby & Co. 1938. Price 16s.)

Although many books covering various phases of agricultural chemistry have been published in recent years, this treatise is somewhat unique in that it deals with agricultural analysis only. It is a laboratory manual giving details of methods for the analysis of fertilizers, feeding stuffs, milk and milk products, insecticides and fungicides, and is intended for agricultural analysts with limited library facilities, research workers and advanced students

An introductory chapter gives references to and descriptions of various publications in which data can be found giving the extent of variation and average composition of substances dealt with in succeeding chapters. Following this chapter is one dealing with the preparation of the sample, an essential part of the sound training of an analyst, but one which is not always realised by the student.

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NOTES FOR THE MONTH

The Livestock Commission

The Livestock Commission, in a report recently published, review their activities during the period from August 1, 1937, to March 31, 1938. After describing the organization of the Commission, the report deals with the cattle subsidy and surveys the arrangements made to effect the change over from the temporary Cattle Subsidy Scheme to the Cattle Subsidy Scheme of 1937. The number of animals certified in the United Kingdom in the period under review was 1,031,866, 10.3 per cent. less than in the corresponding period of 1936-37. Imported animals comprised 26.6 per cent. of the total animals certified. In all four countries comprising the United Kingdom, the proportion certified as of quality standard was higher in imported than in home-bred animals. The percentage of all animals certified as of quality standard was 42.5 per cent. in England, 20.5 per cent. in Wales, 80.9 per cent. in Scotland, 9.6 per cent. in Northern Ireland, with an overall average of 47.3 per cent. for the United Kingdom.

At live-weight centres the average price per live cwt. for all cattle was 41*s*. 6*d*., as compared with 35*s*. 2*d*. in the corresponding period in the previous year. Quality standard animals commanded, on the average over the United Kingdom, 4*s*. 5*d*. per live cwt. more than animals certified as of ordinary standard.

The report outlines the broad effect and underlying objectives of the provisions of the Act in regard to the regulation of markets. Particulars are given of markets, the improvement of which, either by way of extension or removal to other sites, has been formally approved by the Commission, but it

is emphasized that the greater part of the Commission's work in relation to markets, during the period under review, was advisory and directed to securing improvements in existing markets irrespective of the question whether or not those improvements would require formal approval under the Act.

The Commission state that at an early stage they realized the necessity for an authoritative statement on the best layout for an efficient market, and at March 31, 1938, they had in preparation a memorandum, which has since been issued (free of charge) as Livestock Commission Leaflet No. 1. The Commission recommend that all livestock markets should be designed so that all animals of a particular class are penned in a separate section and sold through a ring.

Dealing with the slaughtering of live stock, the Commission point out that, although from time to time it has been suggested that many processes, which are at present unknown in this country, will be incorporated in the experimental slaughter-houses, the actual position is that there are already in different parts of the country establishments where the live stock, meat and by-products are treated with economy and efficiency. In nearly all instances, however, the trade is handicapped by inadequate facilities for lairage, cooling of meat and treatment of by-products, and by the fact that, in the case of raw offals, considerable depreciation occurs between the slaughter-house and the by-product premises. The Commission suggest that the central slaughter-house premises will probably be not so much experimental as demonstrational, in the sense that many processes, which at present are carried on apart from the slaughter-house, will, for the first time in this country, be brought together under one roof. On the other hand the provisions of a slaughter-house scheme enabling all slaughtering to be controlled within a wide area are experimental in character.

At March 31 the Commission had in preparation memoranda on the following subjects:—

(1) Area of a slaughter-house scheme
(2) Principal features and desirable operations at central slaughter-houses.
(3) Compensation for closure of slaughter-houses under a slaughter-house scheme.

These memoranda have since been issued (free of charge) as Livestock Commission Leaflet No. 2.

The section of the report dealing with the Cattle Fund con-

tains some interesting information regarding the amount of subsidy paid to producers during the period under review and the costs of administration. The total of subsidy payments during the eight months was £2,677,450, which includes £91,573 paid in respect of animals which were certified on or before July 31, 1937, i.e., under the Emergency Scheme. The division of the total amount of subsidy paid as between England, Wales, Scotland and Northern Ireland was £1,762,111 (65.81 per cent.), £131,312 (4.91 per cent), £641,996 (23.98 per cent.) and £142,031 (5.30 per cent.) respectively.

Frost Damage to Fruit

With the gathering of the fruit crop, it has now become possible to assess more accurately than earlier in the season the extent of the losses caused by the May frosts. It need hardly be said that in parts of the country the frosts prevented the possibility of a satisfactory crop. At Wisley they were so severe that practically the only variety of apple in the National Fruit Trials that bore a crop was Crawley Beauty, which blossomed sufficiently late to escape damage. In orchards where the frost damage was less severe, some varieties bore satisfactory crops, others light crops and some nothing.

It was felt that the experiences gained over the country might provide information of interest and value, and the Ministry's Horticultural Inspectors were asked to report on the cropping of the several kinds in their particular areas. The results of this inquiry are summarized below.

One factor of importance has emerged, namely, that where varieties were mixed and fertilization was possible, the crops were better than was expected. In some instances trees of Bramley Seedling and Cox's Orange Pippin bore fair crops when adjacent to trees of Worcester Pearmain, but practically no crops when Worcester Pearmain was absent. Some of the reports mention that varieties have given crops this year on Type IX stock and failed to do so when worked on other stocks. Ringing, too, seems to have given trees some degree of resistance to frost, for crops on ringed trees have been fair.

APPLES. As far as apples are concerned, all Inspectors report that Bramley Seedling, Cox's Orange and Charles Ross have invariably given poor crops, evidencing their susceptibility to frost damage. On the other hand, Worcester

Pearmain, Laxton's Superb, Ellison's Orange, Lord Derby and Grenadier seem not to have suffered as badly from frost and crops were appreciable in most areas. Between these two extremes comes Edward VII, Lord Lambourne, Beauty of Bath, Newton Wonder, Lane's Prince Albert, James Grieve. Crops of these were seldom satisfactory and often poor though there was much variation from area to area.

PLUMS. The Victoria crop was light or negligible in all districts, indicating that Victoria is one of the most susceptible to frost damage; Belle de Louvain and Blaisdon Red gave very small crops; Czar, Monarch, President and Giant Prune gave fair crops and may be regarded as somewhat resistant. The Purple and Yellow Pershore cropped irregularly: in some districts the yield was satisfactory, in others very light. On balance, most Inspectors were inclined to report Purple Pershore as a resistant kind.

There are, of course, several stages of growth in fruit blossoms, and each stage may vary as to its susceptibility (or resistance) to frost. For this reason much variation in behaviour from district to district is to be expected.

Chrysanthemums

The past summer has been a very difficult one for the successful cultivation of chrysanthemums. Artificial watering has been necessary during the whole of the time that the plants have been in the open. In general, watering was necessary before the rooted cuttings could be planted out and this, as a rule, was carried out with a hose. As the dry weather continued, however, more and more growers became dissatisfied with hose watering and many of them installed various kinds of sprinklers and " rain machines " with the advantages that may now clearly be seen. Where only the hose has been used the blooms have been late, whereas the use of a machine has brought the blooming period almost up to normal for the season. The actual growth of the plants has not shown a wide disparity under the two systems, but since the machine enables the plants to make better use of a given quantity of water, a considerable saving in time and labour is effected as an off-set to the cost of installation.

SHEEP MANAGEMENT ON A KENT FARM

N. V. HEWISON,

Farm Manager, South-Eastern Agricultural College, Wye

To those farmers engaged in sheep farming during the past nine months the outlook has been anything but good. Prices of both breeding and fat sheep have steadily declined from the beginning of the year, and when we come to compare the returns from this section of the farm with those of the previous year, the comparison makes very poor reading. The question that at once arises is: " Are the sheep paying their way? " Another question that we should ask ourselves is: " Are we as farmers doing our utmost to make the sheep pay? " This latter question, if we are really honest with ourselves, is a very big one and involves many aspects of the job, viz., is our land (pastures in our case) as good as we can make it? Is our management all that it should be to get the most out of the sheep we farm, and is the breed of sheep we keep the most suitable for the production of the mutton or lamb we have in mind? Here I would hasten to add that I do not know of any one breed or cross breed of sheep that is suitable for all and every condition of land and climate.

In this article I shall endeavour to give an account of our experiences in searching for the breed of sheep best suited to the particular job we required it for, and some details of the management of the flock. I may add that the flock is run on strictly commercial lines, as indeed is the whole farm.

The importance of sheep on the College farm is perhaps best brought home by stating that during the four years ending Michaelmas, 1930, 15.1 per cent. of our farming capital was invested in sheep, and during the same period 21.8 per cent. of the total farm revenue came from sheep. During the next four years, ending Michaelmas, 1934, 21.1 per cent. of the capital was invested in sheep and 25.3 per cent. of the total farm revenue came from sheep.* The numbers of sheep kept on the farm and the management have not altered materially since these dates, so it may be assumed that the capital at present invested in sheep is about 25 per cent. of our total farming capital.

* See Reports Nos. XI and XXI, Department of Economics, South-Eastern Agricultural College

During the past twenty years many changes have taken place in our general management and the class of sheep kept. During the early part of this period pure-bred flocks of Kents and South-Downs were maintained, to a considerable extent, on the fold. Some ram breeding was carried out from both the Kent and South-Down flocks. The South-Down flock was sold off in 1924, and its place taken by Dorset Horn ewes crossed by a South-Down ram, for the production of Easter lamb. This flock was dispersed in 1930. In addition, a considerable number of sheep were bought for fattening, either on the fold or on the pastures.

In 1924, conditions seemed to warrant an increase in the breeding flock and careful consideration was given as to what breed of sheep should be selected for this development. The breed required was one that would give a high lamb average, and an early maturing lamb of a size in keeping with present-day requirements. Further, the selected breed had to be suitable for running on pastures, rather than folding, and, of course, the ewes had to be good milkers, reasonably hardy and capable of wearing well. The Border-Leicester Cheviot cross ewe, commonly called the Scotch Half Bred was the one decided upon. Up to this date the Kent had ruled supreme in this district.

The first lot of Half Breds brought down from the north consisted of 20 ewe lambs and 20 two-tooth ewes. Now our flock consists of just over three hundred of this breed of ewe and the remainder Kent or Kent cross ewes. The Half Breds did well on the College farm, and good though they proved to be, we decided to introduce another breed, this time from Wales, the Kerry Hill. The writer has seen splendid results obtained from Kerry Hill ewes in other districts, but with us at Wye they did not come up to expectations, so, after a six-years' trial, they were sold off.

In 1932 yet another breed, the Masham, was tried. These sheep proved to be prolific breeders and good milkers. The quality of the lambs produced by this breed did not come up to that produced by the Half Breds, and some difficulty was experienced in keeping the ewes in bounds. After a three-years' trial this breed was given up.

The Scotch Half Bred had, for a number of years, given a consistently good crop of lambs. Reckoning from the number of ewes mated in the autumn and the number of lambs sold, the average lamb crop, over a number of years, was 150 per

FIG. 2.—Weighing and marking lambs before sale.

cent. This lamb fall, together with the good milking qualities of the ewe and the quality of lamb produced, proved that the Half Bred ewe was, of the breeds we had tried, the best suited for our purpose. There was, however, one fly in the ointment. At the time we were building up this flock of Half Breds the breeding stock was very high in price. The ewes (two-tooth) in one year cost us just over £5 each by the time they reached Wye. This high price led us to consider whether or not we could furnish our own replacements by breeding them on the farm. To carry out this trial we purchased eighty Cheviot ewes and two Border-Leicester rams. For several reasons this trial was not a success. Firstly, if we kept the Cheviots at home, the Half Bred flock had to be reduced to make room for them, and, secondly, we considered our pastures were worth a better job than rearing a breeding sheep on them. In view of this it was decided to put the Cheviots out to keep on land which was poorer than our own, but still considered quite good enough for the purpose. This was not altogether a success. The sheep appeared to miss the everyday attention they would receive at home. The shepherding was not too well carried out and after two seasons this method of rearing our breeding stock was reluctantly abandoned. I say reluctantly abandoned because I believe that much of the poorer hill land in our district could be used in this way and be made to produce more than it is doing at present.

Another method tried for breeding our own replacements was to mate the Half Bred ewe with a Half Bred ram, and to save the ewe lambs resulting from this mating to make up the flocks. This has also been given up and we have returned to our original practice of purchasing our replacements in Scotland, taking care to buy good sheep off sound farms.

Management of the Half Bred Flock. Our aim is to get as high a cash return per ewe as possible and to manage the ewe in such a way as to prolong her breeding life. The type of Half Bred ewe favoured at Wye, is the large, rangy ewe, bred in the north of Scotland. The expense of bringing the ewes to Kent is high. We therefore want a long life from the ewe, so as to spread this expense over as many lamb crops as possible. The ewes are purchased as two-tooth ewes and kept on the farm until they have reared six crops of lambs, after which they are sold.

We have used various breeds of rams on the Half Bred ewe: Suffolk, Hampshire, South-Down and Half Bred. In our local market the South-Down cross lamb is much more saleable than any of the other crosses we have tried. The South-Down Half Bred cross lamb is excellent quality and much sought after by the butcher. Since 1930 no lambs have been drawn off for the weekly market, the whole lot of lambs are sold at the first lamb sale which takes place during the third week in July.

The ewes are run entirely on pasture, in lots of from forty to fifty. This number we consider more easily shepherded than big flocks, and when it comes to trough feeding all ewes get a better chance of receiving their fair share of concentrates. The ewes are run fairly thickly at about 2½ to 3 per acre during the winter and their lambs extra during the summer. Mating takes place from the middle of October and the ewes get their living off the pastures until mid-December, when trough feeding commences. Care is taken to bring the ewes to lambing in good condition, the trough food being increased as the grass gets less, so that each ewe is receiving 1 to 1¼ lb. of concentrates at lambing time. This allowance of corn may appear liberal to many sheep farmers, but it must be remembered that the sheep are not moved on to fresh pastures frequently. They often remain in the same field from mating time until the lambs are sold off them. In addition to the concentrates fed, the ewes are given an allowance of 4 to 5 lb. of mangolds each per day, from about mid-February until mid-April. At this time of the year the pastures on which sheep have been running all winter are very bare, and the mangolds are much relished by the ewes.

Lambing commences about mid-March in the open and, so far, has caused little trouble. No attempt at building a lambing pen is made. The three hundred and fifty ewes are spread over eight or nine fields and thatched hurdles are erected for shelter. The shepherd is in attendance during daylight; after dark the sheep are left to themselves. Each lamb has its navel dressed with Iodized Phenol as soon as possible after birth. Tailing and castrating are carried out at about ten days old. Lamb creeps are erected near the troughs from which the ewes are feeding, and every effort is made to get as many lambs as possible to eat concentrates. By the time trough feeding the ewes is discontinued (about the end of April), a large percentage of the lambs should be

eating concentrates. We believe that it is not possible, economically, to over-feed a lamb up to the age of four months. By starting early and by using an appetizing mixture of food, it should be possible to get lambs to consume ½ cwt. each by the time they are sixteen weeks old. To induce the lambs to eat more concentrates we feed twice a day from the beginning of May. A mixture of one part linseed cake and two parts flaked maize has been found a very suitable food for the lambs. The suckling lamb is a very choice feeder and much depends upon the shepherd as to the way in which the lambs take to trough food.

The ewes and lambs are regularly dipped and we attach great importance to this part of sheep management. In addition to summer dipping the ewes are dipped in the autumn, before going to ram. This should keep the sheep clear of Keds, etc., which, if present, cause sheep much discomfort and later get on to the lambs. Another important point is to keep the sheep sound on their feet. Regular attention is given to paring the feet and the sheep have an occasional run through the foot bath, whether they have foot rot or not.

Contrary to local custom our lambs are not shorn, it being considered that this cross bred lamb sells better in the wool. In 1937, as a trial, the lambs were shorn. We obtained 1 lb. of wool per lamb, which was worth about the same per lb. as the wool obtained from the ewes. It is claimed that the shorn lamb is more easily shepherded. A further claim is made that the shorn lamb will do better than when left in the wool. If trouble is experienced with maggots the former claim is undoubtedly true; as to the second claim, that of doing better, the trial we carried out did not support this.

Disease. This question of disease, especially where sheep are run thickly, is often a serious one. Every effort is made to keep the ewes and lambs healthy. Stomach worm is perhaps the most troublesome, and, to combat this, regular drenching with a mixture of copper sulphate and nicotine sulphate is carried out. The ewes and lambs are drenched in May, June and July and the ewes again in the autumn and winter if they require it. Drenching, as described above, is certainly effective if the sheep or lambs have stomach worm, but a much better method is to graze the sheep on clean pastures, and it is here that our temporary pastures are so valuable. Another troublesome disease is Pulpy Kidney. This is

generally found during the early summer, especially amongst lambs that are thriving particularly well. On farms where the management aims at getting the greatest possible number of fat lamb off, this disease appears to be on the increase. During the past season, half the Wye lambs were inoculated with a special culture against this disease. In this case no difference was found in the treated lambs as against the controls as no losses from Pulpy Kidney occurred in either group. Great claims are made for this treatment and where trouble occurs with good lambs (an unthrifty lamb never dies from Pulpy Kidney) dying suddenly, it should be worth while investigating this treatment. A veterinary surgeon should be consulted.

Pastures. It is obvious that successful results from grassland sheep depend largely upon the management of the pastures. On the College farm our permanent pastures are regularly slagged, receiving a dressing of 10 cwt. per acre of high grade Basic Slag every fourth year, plus potash if required. But much the best results are obtained from sheep that are run on the temporary pastures. From our observations we find that the temporary pastures do not carry so many more sheep per acre than do the permanent pastures, but it is the much more rapid gain in weight of the lambs on the temporary pastures as compared with those on permanent pastures that counts. Our practice is to leave the temporary pastures in grass for three years, after which they are ploughed out and cropped for four years. We are satisfied that under present conditions this method of farming our class of land is financially sound, and we are extending the practice by ploughing out the permanent pastures, so that in time the whole of the farm will be under this rotation. By this method we hope to increase the output per acre considerably, not only in extra live weight per acre of lamb produced, but extra output from the land during the time it is under the plough. For our temporary pastures a fairly simple seeds mixture is used consisting of 4 lb. Wild White Clover, 12-16 lb. Perennial Rye Grass (grazing strain) and 2 lb. Rough-stalked Meadow Grass. This is chiefly for sheep grazing. The seeds mixture is sown in the spring, usually in barley. By using a liberal allowance of Wild White Clover in the mixture we hope to obtain a really good pasture in the first year. If a really strong growth is obtained, ewes are put on the young seeds

six weeks after the corn crop has been harvested. If, as often happens in our rather dry climate, the clover and grasses have made little growth by harvest time, the sheep are not turned on to them until the following spring.

If we are to get the best results out of our sheep we must have good sheep, whatever the breed or cross of ewe kept. We must have good pastures, and it is surprising how poorish land can be made to produce these good pastures by proper management. Finally we must have good shepherding. As farmers we have comparatively little control over the prices at which our lambs are sold, but in the management of our flocks and the land we can do much to increase the return per ewe.

It will be gathered from this account of our sheep management that we have been to some trouble and expense in our search for the ewe that would best suit our purpose. We do not however, consider that we have reached finality as regards this business of sheep farming. We are always on the look-out for a better sheep or a better way of managing the sheep we have.

THE RENTING OF DAIRIES IN DORSET

MISS D. M. EVANS, B.Sc.,
County Instructress in Dairying

The practice of renting dairies in Dorset is one of very long standing in the county. It consists of the letting of a herd of cows to a dairyman by a farmer at a fixed rate per cow per annum and according to various conditions laid down by contract. Herd owners themselves have found it more profitable to manage the cows for milk-selling, whereas formerly they had hired out the stock to a man who, with the aid of his family, was capable of making up the produce in the form of cheese or butter. The practice is still carried on in parts of the county. This system was very prevalent during the 19th century, particularly when cheese-making and butter-making were general and sheep and corn formed the farmer's main interest. In recent years the number of dairies managed on these lines has been much reduced as milk-selling became widespread. Details of the system are as follows:—

Rental. This varies on different farms according to the type of land, cow, etc. At the present day the figure may be taken at between £15-£17 per cow per annum. In the last century £10-£12 per cow was a general figure. This rental per cow includes the occupation and use of the dairy house, garden, cowstalls, piggeries and adjacent buildings, together with the use of a suitable and stated amount of pasture and afterfeed. The rent is payable in four quarterly instalments on January 1, April 1, July 1 and October 1, the first instalment at least being paid in advance. The term of letting runs from January 1 to December 31. The farmer undertakes that certain proportions of the herd shall be in milk by given dates, e.g., in a 52-cow dairy for cheesemaking, eighteen shall be in by February 14, thirty-five by March 14, and the whole number shall have calved down by April 1. If these proportions are not adhered to the farmer allows compensation to the dairyman at so much per cow for each week they are not in profit, or, alternatively, makes up the number of cows.

Feeding. A stated minimum quantity of cake to be used is laid down in the contract. Usually, payment for this is equally shared and any excess is provided by the dairyman. So much land per cow is set apart on the farm for hay for the dairy. The onus of cutting, making and carrying the hay

is on the farmer. The aftermath is used by the dairyman. The farmer must not stock the land on which the cows run, and he is responsible for hedging, ditching and fencing. The dairyman in his turn must keep weeds down. Straw is supplied by the farmer and manure is carted back to the land by the farmer.

Management of the Dairy. The dairyman undertakes to manage and adequately care for all the cows whilst they are in his possession, and to keep proper cowshed records. These records are to be available to the farmer at any time. Each cow's calf becomes the property of the dairyman. If any cow has a dead calf a rebate is made on the rent of the cow.

A stipulation is made that the dairyman should rear a certain number of heifer calves each year for replacement in the herd. These are taken over by the farmer at valuation about May 1 and removed out of the dairy.

All cows have to be returned to the farmer by the dairyman within a stated number of weeks of calving and all barreners by a certain time laid down in the agreement.

Other Stock Kept by Dairyman. A maximum number of sows is usually stipulated, but the dairyman is allowed to keep all the fattening pigs he can accommodate, definite land being set apart for the exclusive use of a horse and pigs.

Geese are usually debarred, but poultry may be kept up to any number, though often with a proviso that they are kept as far as possible out of standing grass or concentrated as much as possible round the yards.

Labour. All labour in connexion with the milking, feeding, cleaning and management of the cows is supplied by the dairyman, his family or employees. All dairy utensils are the property of the dairyman and are supplied by him.

Various other details, such as the supply of faggots of wood, restrictions as to using a dog with the cows, etc., enter into different agreements.

That this system has in the past been capable of bringing good returns to the renting dairyman cannot be disputed. Many successful farmers to-day have started in this manner. In the 'eighties, when numbers of old-established farmers were leaving their farms, in many instances the dairyman proved to be the new tenant.

SPECIMEN CONTRACT

TERMS OF AN AGREEMENT FOR LETTING DAIRY, IN THE PARISH OF IN THE COUNTY OF DORSET, THE PROPERTY OF

DESCRIPTION. The dairy of fifty-two Devon and Crossbred cows and heifers, with the occupation and use of the Dairyhouse, garden, cowstalls, piggeries and all the adjacent buildings, together with the pasturage or afterfeed of the following fields, namely :—

* * * * *

together with the plot known as for the exclusive use of a horse and pigs, such horse and pigs not to be permitted on any other field

TERM. The term of letting shall be from January 1 to December 31.

RENT. The rent shall be £936, being at the rate of £18 per cow, payable in advance in four quarterly instalments on January 1, April 1, July 1 and October 1.

LESSORS' COVENANT The lessors covenant . (1) to provide fifty-two cows and heifers with their calves of average character, at least eighteen of which shall be in profit by February 14, thirty-five by March 14, and the full fifty-two by April 1.

(2) to allow the lessee compensation at the rate of 10s a cow per week for all cows up to the aforesaid proportions or numbers not in profit by the above dates

(3) to allow the lessee as many faggots of wood as he may require up to a maximum of two hundred

(4) to supply not less than eight tons of cake or corn each year, half the cost of which shall be borne by the lessee

LESSEE'S COVENANTS The lessee covenants .—(1) To pay each instalment of rent on the date it becomes due

(2) To well and properly care for, manage and attend to all the said cows while they are in his possession, and not use a dog with them

(3) To give up all cows within eight weeks of their calving, and all barreners by November 1 Any cow considered unfit for dairy purposes shall be returned with her calf to the lessors within a fortnight of its having come into the possession of the lessee

(4) To keep a proper record of the names and seasons of the several cows, and to produce same, and give full information to the lessors when required

(5) To measure and record all milk produced both morning and night by each cow, at least twice in every week during the period of lactation

(6) To rear, if required by the lessors, any number of heifer calves up to fifteen, such calves to be reared to the best of the lessee's ability, and taken over by valuation on or about the first day of May

(7) Not to keep geese, and as far as possible, to keep all poultry out of standing grass

(8) To make good all broken glass

(9) To pay the first quarter's rent upon signing the agreement

(10) Not to allow any of the cows to take season before the 25th day of March unless with the full permission of the lessors

Any dispute arising under this agreement shall be settled by arbitration

Provided always that if any rent is in arrear for twenty-one days, and there is no sufficient distress on the premises, or if the lessee becomes bankrupt, or compounds with his creditors, or executes a bill of sale or an assignment of his effects, or suffers his effects to be taken in execution, or commits any breach of this agreement, then the same shall forthwith determine, and the lessors shall retake possession of the said cows, lands, and premises.

I agree to rent the aforesaid Dairy of cows and premises on the terms herein set out.

Dated this day of 1925
Signed by the aforesaid in the
Presence of

Stamp.

MECHANIZATION

S. J. Wright, M.A.,

Director, Institute for Research in Agricultural Engineering, Oxford

Just ten years ago the combine harvester first made its appearance in this country and, very shortly afterwards, the term " mechanized farming " came into use. The fact that the combine became, in effect, the immediate symbol of mechanization was due only to the unwarranted publicity given at the time both to the machine itself and to some of the farms on which it was first used. To-day it is possible to take a more rational view and to realize that our farming is built on firmer foundations than can easily be upset by any one machine or group of machines. We may note, in fact, that after ten years of progress—and in spite of almost universal success wherever they have been tried—less than one per cent. of our corn acreage is harvested with combines. Yet, during the same period, other developments, less spectacular in themselves, but covering a much wider scope, have proceeded so rapidly that we must soon either forget the term " mechanization " altogether, or give it so wide a meaning that it covers practically the whole of our agriculture.

This does not, of course, mean that the equipment of all, or even of the greater part of our farms, has been brought up to date. Indeed, there are many obvious limitations: some holdings are too small or too much broken up by hedges and roads to be able to make effective use of modern implements; not all types of farming have as yet been equally favoured by machinery developments; while, in only too many instances where these restrictions do not apply, progress has been hindered by lack of capital coupled with a general sense of uncertainty about the future of agriculture. But, in the meantime, practically all the original prejudices against the general idea of mechanization have disappeared—simply because time has shown them to be ill-founded—while during the last few years new methods and machines of one kind and another have been so widely used all over the country that few farmers can be completely ignorant of their uses and possibilities. We have, in fact, reached the stage at which every farmer who is taking up a new holding—or who is attempting to reorganize his

present one to meet existing conditions—must, in his own interests, give at least some consideration to the possible uses of mechanical power and equipment.

That farmers to-day are indeed anxious to get information about machinery developments is shown by the many enquiries on the subject, and by the interest which is aroused all over the country by lectures and conferences on mechanization. But, up to the present, apart from short papers and articles dealing with particular types of equipment, there has been a conspicuous lack of published information. Just how serious this lack has been up to now has been brought home, to the present writer at any rate, by the appearance, at long last, of a new book on Farm Machinery,* and the realization that, as far as this country is concerned, the last publication of the kind was written before the Corn Production Act was repealed. The new work describes the full range of modern farm equipment very concisely and in its proper relation to the general agricultural background.

As is appropriate, it deals first, and at some length, with the agricultural tractor; recording, incidentally, that according to an official estimate over 46,000 tractors were at work in this country in the autumn of last year. Just what this number actually means in terms of our agriculture as a whole can be gathered by realizing that, at a conservative estimate, the combined power of our present tractor force is sufficient to cultivate at least one-third of our total arable acreage entirely without the aid of horses. This is a very solid achievement—out of all proportion to what has been, or is likely to be achieved by the more spectacular devices like combines, grass dryers, and rotary tillers, which from time to time capture the popular imagination.

However, with complete impartiality the new book gives up-to-date information both about these more exclusive devices and about the hundred and one every-day farm appliances, whose very variety warns us against placing too much emphasis on the large machine or even on the tractor itself. On reading it we realize that the combined power of our tractors is still, in all probability, small by comparison with the power contributed by the humble portable engine which nearly every farm uses in one form or another. (And, curiously enough, a farmer can buy any number of portable

* *Farm Machinery.* By C Culpin, M.A., Dipl. Agric. (Cantab.). Crosby, Lockwood and Sons, Ltd 18s net.

engines without being suspected of having mechanical tendencies.) Moreover, the tractor is mainly associated with arable farming, so that, unless our general agricultural layout changes considerably, its potential influence must in the long run be very much narrower than that of the dairying, food-preparing, dung-handling and other machines which, now or in the future, are to be associated with stock farming. Again, in some branches of both stock farming and horticulture, new and far reaching possibilities have been opened up by electrical developments.

And, finally, even within the tractor's normal sphere of operation one must not overlook the progress that has been made in both the design and use of general equipment—haymaking and harvest machines, drills, fertilizer distributors and a host of other implements—which may very often be operated by mechanical power, but which, for the most part, cannot be said essentially to depend on it. All these developments and the many others that are described, provide one good reason why books on farm machinery have been so few and far between: progress is so rapid that even now any writer on the subject must face the risk that his work may very quickly become out of date. However, this is a risk worth facing and one which, as in the present instance, can to some extent be guarded against by proper treatment.

Thus, one of the most interesting features of this particular book is the fact that in every section the earlier development of the machines concerned has been sketched, so that each of them is represented, not just as an isolated device for one purpose or another, but as the most recent link in a continuous chain of evolution. The result is that the reader is given the right impression: that the subject is a progressive one, on which the last word will never be written, but about which the latest word is very well worth having.

Any book of this kind is clearly of the utmost interest to farmers; who, more than ever before, need to keep abreast of current developments and to be able from time to time to weigh up their existing implements in the light of whatever more up-to-date equipment may be available. But it is in connexion with agricultural education that books on machines and everything connected with them are most needed: and it is no criticism of the work in question to say that its publication suggests several others that ought to be written.

Sooner or later we must recognize that machinery progress

cannot be retarded; that, on the contrary, the whole trend of wages and conditions of labour demands that it should be accelerated; and that, in consequence, the success of the farm of the future must become ever more dependent on engineering knowledge. And, whatever difficulties may arise from an already over-crowded syllabus, we must make provision for imparting this knowledge, in both theoretical and practical form to students of agriculture.

On the practical side we must prepare for the fact that not only will succeeding generations use more machines, but, with the advent of mechanical power, the relative importance of each individual machine will increase. A broken-down tractor may very well be as important a matter as six or eight sick work-horses; a defective milking machine as serious as half-a-dozen broken arms.

On the theoretical side we must do our best to bridge the gulf which, for a hundred years at least, has divided the men who make agricultural machines from the men who use them. Some, at any rate, of our rising generation of agriculturists must be given enough knowledge of engineering principles to meet the implement designer on his own ground for the benefit of the community at large. Culpin has made one useful move in this direction by assembling, in an appendix to his book, as much as he considers it necessary that a student of agriculture should know of applied mechanics. One might wish that he could have gone further and have given more indication of the relation of this theoretical knowledge to the design of the machines which he describes. But that would have meant a treatise on agricultural engineering: a book such as will probably not be written for another twenty years: but the lack of which, in the meantime, will be a constant reproach to agricultural engineers.

GROWING PLANTS WITHOUT SOIL BY NUTRIENT SOLUTION METHODS

W. G. TEMPLEMAN, M.Sc., D.I.C.,

AND

S. J. WATSON, D.Sc., F.I.C.,

Jealott's Hill Research Station, Bracknell, Berks

For many years it has been known that plants can be grown in nutrient solution culture, without soil, provided that the nutrient solution contains the necessary elements in sufficient quantities to maintain the growth of the plant. In fact, this method of growing plants is much used in the teaching of biology, for the demonstration of the effects of various substances upon the growth of plants, whilst students of plant nutrition have freely resorted to it in many academic researches. It is only recently, however, that attempts have been made to utilize the nutrient solution culture method for the growth of crops of commercial importance and on commercial lines. Preparations of nutrient salts for this purpose have now appeared on the market under various trade names. In California and other places in the United States where apparently commercial installations are in action,[5] * crops have been grown by nutrient solution methods, and claims have been made that the yields and quality of produce so obtained are much better than from normal soil-grown plants. Most of these reports are of a popular type, and should be regarded as being as yet unconfirmed by carefully controlled experiments. In none have data appeared for a direct comparison of plants grown by solution culture methods and plants grown under the best known soil conditions, both series being subject to identical conditions of light, temperature, spacing, etc. Further, assuming that the results obtained by nutrient solution culture are at least as good as by normal soil methods, then the conditions which must prevail in order that such commercial crop production may be an economic proposition are also undetermined.

In view of the interest which has been aroused in this question and its possibilities as a method of commercial crop production, experiments have been carried out at Jealott's Hill Research Station to obtain definite data for crops grown by

* For references see p. 781.

nutrient solution methods under English conditions. These experiments are in a preliminary stage, and are being continued. It is proposed here to detail the various methods in use in America, and to indicate from our experience the results so far obtained, points of interest and questions demanding further attention.

Nutrient Solution Methods. There are four methods of nutrient solution culture:—

(i) Solution Culture, as developed at the University of California Agricultural Experiment Station ([1]),
(ii) Sand Culture, in which nutrients are applied to plants growing in sand,
(iii) the Sub-irrigation Method in use at Purdue University Agricultural Experiment Station ([3]), and
(iv) the Drip-Culture Method of the New Jersey Agricultural Experiment Station ([4])

(I) Solution Culture. Dr. W. F. Gericke, working at the University of California Agricultural Experiment Station, has used this method extensively. Briefly, it consists of growing the plants in a medium of little or no nutrient value, in a basket made of wire netting suspended over a tray or tank containing the nutrient solution, into which the roots penetrate. As the solution in the tank becomes exhausted, it is replaced by freshly-prepared solution.

The tanks used in this method may be made of wood, metal or concrete. At Jealott's Hill we have used metal and teak troughs (see Figs. 2, 4, 6 and 7), and for smaller experimental work, glazed earthenware pots (Figs. 1, 3 and 5). Neither the teak nor the glazed pots require a protective coating, but, nevertheless, wood may need to be treated in some way to ensure watertightness. Metal requires painting with some protective material to prevent corrosion, and concrete should be treated on account of its calcareous nature. Some anti-corrosive enamels are now under trial, but it is reported by Withrow and Biebel[3] that petroleum asphalt (melting point 175°-185°F.) is suitable for this purpose, and can be applied easily when hot. Roofing tars are very toxic to plants, and only a well-tried grade of asphalt should be used or, alternatively, a small-scale trial should first of all be carried out before any extensive coating takes place. On no account should untreated galvanized iron tanks be used, as they may give rise to zinc poisoning.

The tanks may be of any convenient size, and should be 3-6 in. deep. They must have suitably fitting grids or bas-

kets of plain iron (not galvanized) wire netting, uncoated or coated with a suitable material. The tanks are filled to within ½ in. of the netting with a suitable nutrient solution, and the wire basket is filled with peat, wood wool or excelsior, or rice hulls to a depth of 2-3 in. At Jealott's Hill the netting of the basket has been of ¾-in. mesh, and the bedding medium is retained in it by using loose hessian sheeting, known as "scrim," spread over the netting. Wood wool or excelsior could also be used for this purpose.

The plants, previously grown to a suitable size in soil or sand in pots, are transferred to the medium. Surplus sand or soil is removed from them, the roots are worked down toward the "scrim" and netting and then firmly fixed in position by packing the bedding medium around them. Judicious watering of the medium is necessary, especially during the period immediately following planting out and before the roots have grown through the basket to the solution beneath. Figs. 5 and 6 show the root development through the medium into the solution. With certain crops it may be possible to sow the seed directly in the medium and thus avoid transplanting.

Attention may have to be given to maintaining the temperature of the nutrient solution. We have achieved this by using a length of electrical, soil-heating cable under each tank and lagging the sides and underneath of the tank with asbestos wool. An even temperature is maintained by the insertion of an adjustable thermostat into each tank, and this controls the current flowing through the soil-heating cable.

During the subsequent growth of the plant, a means of support must be provided wherever necessary.

(II) Sand Culture. Plants are grown in sand to which the necessary nutrient salts are added as aqueous solutions at given intervals. Watering takes place as required between the nutrient applications. This method has been proposed by Biekart and Connors at the New Jersey Agricultural Experiment Station for the commercial production of carnations.[2]

We have used this method extensively, but only on an experimental scale, for the successful growth of tomatoes and many other plants. Only where close attention can be given to watering, etc., is it to be recommended. From a commercial point of view it has several defects. The plants require as much, if not more, watering than when grown in soil, and there is a tendency for the nutrients to be washed down to the

bottom of the tank. There may be a loss of nutrients, since drainage must be allowed.

(III) Sub-irrigation Culture. Withrow and Biebel[3] of the Purdue University Agricultural Experiment Station have devised the sub-irrigation method of nutrient solution culture to overcome the defects of culture method II and to obviate the necessity for watering so as to ensure that the plant roots receive a regular supply of plant nutrients.

A bed of sand, gravel or cinders in which the plants are set out is periodically flooded from beneath with nutrient solution throughout the day and night, and then allowed to drain. Such flooding can be brought about by hand by raising and lowering the reservoir at given times, or automatically by an electric pump controlled by a time switch.

At Jealott's Hill this system has not proved satisfactory if the sand is too fine. Withrow and Biebel[3] state that only particles ranging from 1/20th to ¼ in. should be used and, further, we have found that such gravels are often unsuitable owing to their calcareous nature. Care must be taken to use lime-free gravel, and to observe other precautions mentioned in the Purdue University publication,[3] such as making certain that the medium used contains no toxic materials. The advisability of continuous leaching with acidified water before use should also be noted.

Similar attention should be paid to coating the tanks or benches, as was described under Solution Culture.

(IV) Drip-Culture Method. Another modification which eliminates the disadvantages of the simple sand culture method is that of Shive of the New Jersey Agricultural Experiment Station,[4] known as the "drip-culture" method. Under this system the nutrient solution is continuously applied to the plants growing in sand, by allowing it to drip on to the sand from a series of jets fed from a reservoir. The solution which percolates through is returned to the reservoir and used again.

Fig. 8 shows such an arrangement. The barrel on the left is the reservoir, and the solution is fed on to the sand by the glass tube, which has small openings at intervals along its length.

Both in this and the Sub-irrigation Method the quantity of solution in the reservoir is made up daily to a predetermined mark with water. In both of these methods, when the old solution is to be discarded, the growing medium should be

flushed through with clean water before the new solution is put into the reservoir.

Nutrient Solutions. Below are given the compositions of a number of solutions which are reported as giving satisfactory growth under commercial conditions.

From the University of California Agricultural Experiment Station it is reported[1] that their "P.N." and "T.C." solutions are satisfactory, and these are as follows :—

	"P.N." Solution Gm. per litre*	*"T.C." Solution* Gm. per litre
Calcium nitrate ($Ca(NO_3)_2.4H_2O$) ..	1·181	0·945
Potassium nitrate (KNO_3)	0·506	0·607
Mono-potassium phosphate (KH_2PO_4)	0·136	—
Monammonium phosphate ($(NH_4)H_2PO_4$)	—	0·115
Magnesium sulphate ($MgSO_4.7H_2O$)	0·493	0·493
	Mgm per litre*	Mgm. per litre
Ferric tartrate ($Fe_2(C_4H_4O_6)_3.H_2O$) ..	6·60	6·60
Manganous chloride ($MnCl_2.4H_2O$)	1·82	1·82
Boric acid (H_3BO_3)	2·92	2·92
Zinc sulphate ($ZnSO_4.7H_2O$) ..	0·22	0·22

The $N:P_2O_5:K_2O$ values in Mgms per litre of these two solutions are as follows :—

	"P.N." Solution	*"T.C." Solution*
N	210	210
P_2O_5	71	71
K_2O	282	282

The solutions recommended by Withrow and Biebel[3] are as follows :—

	Solution 1D Gm per litre*	*Solution 2D* Gm per litre	*Solution 3D* Gm. per litre
Magnesium sulphate ($MgSO_4$)	0·130	0·065	0·065
Mono - calcium phosphate Food grade ($Ca(H_2PO_4)_2.H_2O$) .	0·270	0·135	0·135
Potassium nitrate (KNO_3) ..	0·440	1·100	1·320
Ammonium sulphate ($(NH_4)_2SO_4$) .	0·140	0·140	0·280
Calcium sulphate ($CaSO_4.2H_2O$) .. .	1·520	0·760	0·380
	Mgm per litre*	Mgm. per litre	Mgm per litre
Ferrous sulphate ($FeSO_4.7H_2O$)	25·0	25·0	25·0
Manganese sulphate ($MnSO_4.4H_2O$)	2·0	2·0	2·0
Copper sulphate ($CuSO_4.5H_2O$)	1·0	1·0	1·0
Zinc sulphate ($ZnSO_4.7H_2O$)	1·0	1·0	1·0
Sodium borate ($Na_2B_4O_7.10H_2O$)	17·0	17·0	17·0

* Figures given in Gm. per litre should be multiplied by 1·6 to give the quantities required in oz. per 10 gal., and those given in Mgm per litre by 1·6 to give oz. per 10,000 gal.

The N : P_2O_5 : K_2O values in Mgms. per litre of the three solutions are :—

	1*D*	2*D*	3*D*
N	91	183	243
P_2O_5	152	76	76
K_2O	205	513	614

These solutions contain different levels of nitrogen in relation to the other elements. Solution 1*D* contains least nitrogen, tends to produce the hardest type of growth and is especially valuable during the winter months and early stages of growth of certain plants. 2*D* is intermediate in composition, and 3*D* contains the highest level of nitrogen and is valuable for use during the spring and summer months, when there is plenty of sunlight available, and it tends to produce a softer type of growth.

Withrow and Biebel state that they used fertilizer grade chemicals, and give the following list of alternative nutrient salts :—

Nitrogen salts. Ammonium sulphate, ammonium nitrate, sodium nitrate, potassium nitrate or calcium nitrate

Phosphate salts. Monocalcium phosphate (double superphosphate) or monocalcium phosphate (Food Grade).

Potassium salts. Potassium nitrate, potassium sulphate or potassium chloride.

Magnesium salts. Epsom salts or anhydrous magnesium sulphate.

Calcium salts. Calcium chloride or gypsum

Should substitution in the formulæ given above (1*D*, 2*D* and 3*D*) be desired, it will, of course, be necessary to calculate the amount of the new salt necessary to replace the original salt

These authors also state that care should be taken that the fluorine content of any phosphate salt used is below 1 per cent, and calcium sulphate must be free from calcium carbonate

Shive and Robbins[4] describe three solutions which have given satisfactory results as follows —

	*Gm. per litre**
FORMULA I ·	
Monopotassium phosphate (KH_2PO_4)	0·312
Calcium nitrate ($Ca(NO_3)_2.4H_2O$)	1·062
Magnesium sulphate ($MgSO_4$ $7H_2O$)	0·566
Ammonium sulphate ($(NH_4)_2SO_4$)	0·095
FORMULA II	
Monopotassium phosphate (KH_2PO_4) . .	0·206
Sodium nitrate ($NaNO_3$)	0·338
Magnesium sulphate ($MgSO_4.7H_2O$)	0·544
Calcium chloride anhydrous ($CaCl_2$) .	0·169
FORMULA III .	
Superphosphate (Monocalcium phosphate plus calcium sulphate)	0·306
Sodium nitrate . .	0·338
Epsom salts . . .	0·544
Muriate of potash	0·206

Whichever of the above formulæ is used, the following must be added to the solution ·—

Ferrous sulphate ($FeSO_4.7H_2O$)	10 Mgm. per litre*
Boric acid (H_3BO_3)	1 ,, ,,
Manganese sulphate ($MnSO_4.4H_2O$)	1 ,, ,,
Zinc sulphate ($ZnSO_4.7H_2O$)	1 ,, ,,

* To convert Gm. per litre to oz. per 10 gal., or Mgm. per litre to oz. per 10,000 gal., multiply by 1·6.

The N : P_2O_5 : K_2O values in Mgms. per litre of *Formula I* and *II* are as follows :—

	Formula I	*Formula II*
N .. .	146	56
P_2O_5	163	108
K_2O	108	71

It is not possible to give the values for *Formula III* since these will depend on the grade and analysis of the fertilizers used.

The authors state that in America, if technical grade salts are used, *Formula II* is cheaper than *Formula I*. *Formula III* is prepared from crude salts of the commercial fertilizer grade.

At Jealott's Hill, Dr. A. H. Lewis (unpublished data) has determined the uptake of nutrients by the tomato plant throughout its growth and the following solution was devised to supply the necessary elements in the proportions actually existing in the soil-grown plant.

Monoammonium phosphate ($NH_4H_2PO_4$) .	0·121 Gm. per litre*
Potassium nitrate (KNO_3) ..	0·644 ,, ,,
Calcium nitrate ($Ca(NO_3)_2.4H_2O$) .	0·095 ,, ,,
Ammonium nitrate (NH_4NO_3) .	0·098 ,, ,,
Magnesium sulphate ($MgSO_4.7H_2O$) ..	0·368 ,, ,,

Minor elements have been supplied as Hoaglands " A-Z " solution (6) but if commercial grade salts are used, the following addition to the above solution should be satisfactory :—

Boric acid (H_3BO_3)	1·836 Mgm./litre*
Manganous chloride ($MnCl_2.4H_2O$) .. .	1·18 ,, ,,
Potassium permanganate ($KMnO_4$) .	1·12 ,, ,,
Sodium silicate (Na_2SiO_3)	1·299 ,, ,,
Ferric citrate ($C_6H_5O_7Fe.3H_2O$) .	19·26 ,, ,,

The above solution has an N P_2O_5 K_2O value in Mgms. per litre of 150 : 75 : 300.

PREPARATION OF NUTRIENT SOLUTIONS. In general, it is better to prepare separate stocks of each component chemical, and to mix the requisite quantities of these as required. By choosing suitable strengths for the stock solutions of the minor elements required by each of the solutions detailed above, the necessary dilutions are easily obtained. The phosphate-containing solution and the iron-containing solution should be added last, when the stock solutions are being diluted with water for use.

Before the solution is used, the pH must be adjusted by the use of dilute acid or alkali. All the solutions given above should be maintained between pH 4·5 and pH 6·0. Suitable indicators can be obtained to enable this to be done, and frequent pH determinations of the solutions must be made. Any variation from the desired pH must be corrected immediately by the use of dilute acid of alkali.

PREPARATION, PLANTING AND SUBSEQUENT CARE OF PLANTS. With any of the nutrient solution culture methods, it may be possible to sow certain seeds directly in the medium used, but often it is better to grow the plants in pots in sand, sand-peat mixtures or soil, and transfer them to the tank or water-tight-bench when they have become established. Subsequent care and treatment of the plants should be as for normal soil culture.

* To convert Gm. per litre to oz. per 10 gal., or Mgm. per litre to oz. per 10,000 gal., multiply by 1·6.

Results of Trials at Jealott's Hill. No attempt will be made here to give a detailed account of experiments which have been carried out, but rather to indicate the order of results obtained in the preliminary experiments, and to point out certain items of interest which have arisen.

The earliest experiments were conducted, as shown in Figs. 1, 3 and 5, in glazed earthenware pots, using a model of the system proposed by the California Agricultural Experiment Station. The bedding material was a good horticultural peat, and the solution was the one given above (p. 777). This solution was changed frequently, but no other steps were taken to ensure adequate aeration.

In one experiment tomatoes were used for direct comparisons with soil-grown plants in pots. There was ample replication, and all plants were in randomized positions. The fruit was of good shape, and taste, and picking commenced at approximately the same time on both series. The fruit tended to be small and some from the solution culture plants was affected by Blossom End Rot. The final average crop yields of marketable fruit for the two series in lb. per plant were as follows

	Mean Total Yields
Grown in soil	6·4 lb per plant
Grown in nutrient solution ..	4·2 lb per plant

The amount of fruit borne varied from 4.4 to 8.1 lb. per plant when grown in soil, and from 2.3 to 6.3 lb. per plant grown in nutrient solution.

After these early experiments, a larger-scale installation was set up, utilizing the equipment shown in Figs. 2, 4 and 6. The simple solution culture method (Method I) was used, except that in one series of tanks the solution was allowed to flow slowly through the tanks. The total yield of fruit from these flowing tanks, which was superior to that from the still tanks, but inferior to soil-grown plants, amounted to a mean figure of 4.34 lb. per plant. The range per plant was 1.40 lb. to 7.30 lb. This was an average of 40 plants (4 tanks of 10 plants each).

Figs. 7 and 8 show two troughs, each containing 4 tomato plants, which were set out very late (July 21) and photographed on September 29. Fig. 7 shows the nutrient solution culture (Method I) using rice hulls as a medium, and Fig. 8 is the drip-culture system (Method IV), using sand as the growing medium. These plants, the most recent grown at

Fig. 1. General view of Nutrient Solution Cultures of Tomatoes. Note glazed earthenware pots upon wire baskets and peat as medium.

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FIG 2.—General view of Nutrient Solution Culture of Tomatoes. Note metal tanks and control plants in soil in left foreground

FIG. 3 Close-up of Tomatoes shown in Fig. 1

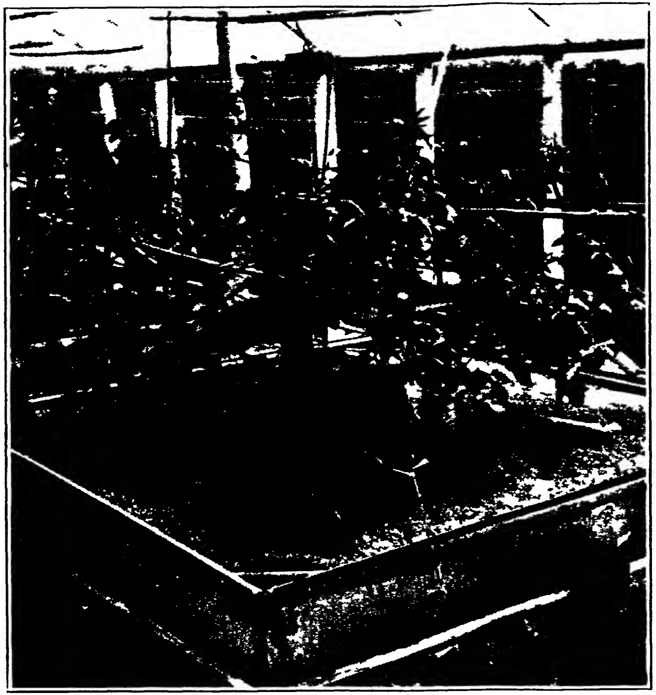

FIG. 4.—Single Tank of the installation shown in Fig. [illegible] Note thermostat and rice hulls as medium

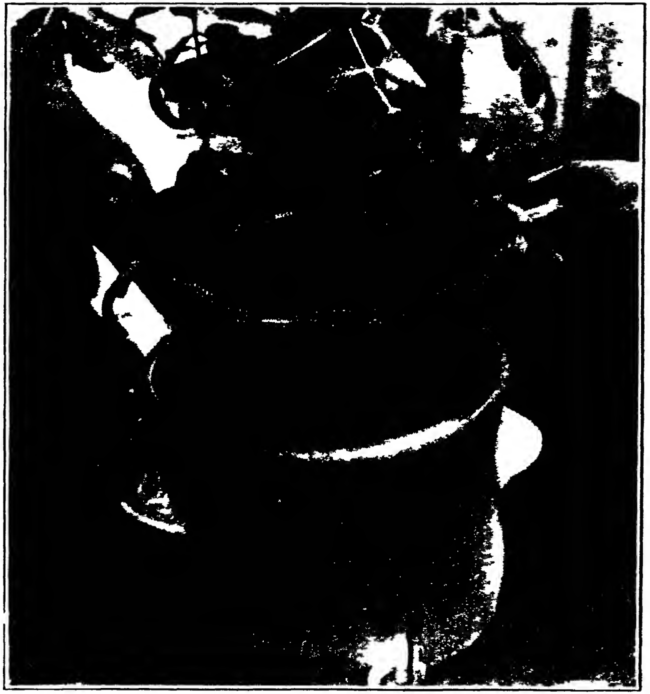

FIG. 5.—Small Glazed Pot showing roots penetrating through netting into nutrient solution

Jealott's Hill, at the time of going to press, appear as good as the controls growing in soil, which are shown in Fig 9.

Attention to Nutrient Solution during Growth. From experience in the Jealott's Hill experiments, there are several points with regard to the solution which call for close attention.

(i) IRON SUPPLY. It has been found that the amount of iron in the nutrient solution may rapidly diminish and, in some instances, in order to maintain healthy growth, additional quantities of the solution of an iron salt have had to be added as frequently as twice a week. Should any pallor or "chlorosis" of the young leaves appear while the pH is at its correct level, an addition of an iron salt should be made.

(ii) AERATION OF THE NUTRIENT SOLUTION. It is necessary for optimum growth that the roots of the plants should be adequately supplied with oxygen, and they should not be subjected to accumulations or concentrations of carbon dioxide.

From this point of view, the Sub-irrigation Method (Method III) and Drip-culture (Method IV) systems are definitely superior to the still culture (Method I) and, to a less extent, sand culture (Method II). Carbon dioxide determinations on the culture solutions of the sub-irrigation and drip-culture systems at Jealott's Hill have proved their efficiency in ensuring satisfactory aeration. One series of tomato plants, growing in still water culture, became seriously affected with Blossom End Rot, a physiological disorder due to a restricted supply of water to the developing fruits. This was eventually traced to an unhealthy and inefficient root system, probably caused by an accumulation of carbon dioxide in the nutrient solution. With cultures of the still type (Method I) it is an asset if a stream of air can be passed through the solution, or the solution be stirred at least once a day.

It is essential that any water used in watering media or "topping-up" solutions should be adjusted to the correct pH. It has been found that when a water with temporary hardness is adjusted to an acid pH, the free carbon dioxide content of the water rises markedly. For our still cultures (Method I), we have removed excess carbon dioxide from all "pH-adjusted water," by a stream of air before use. Such precautions are, of course, only necessary for Method I. Methods III and IV normally provide suitable aeration and are thus to be preferred in many instances.

(iii) CONCENTRATION AND CHANGING OF NUTRIENT SOLUTION. For optimum growth, solutions must not be allowed to become exhausted; on the other hand, we have found that the use of solutions of too high a concentration has caused damage to the plants.

Where analytical facilities are available, it is possible to determine when a solution is becoming exhausted (all methods) or when carbon dioxide is accumulating (Method I only), both of which conditions demand that that nutrient solution should be replaced. Before the exact requirements of various plants under given conditions are worked out, there are two courses open to the practical man.

(i) To change the solution at regular intervals to ensure that no deficiency occurs, or
(ii) to change the solution immediately the first premonitory sign of deficiency appears.

Of these, the former is to be preferred since in the latter damage may have been done to the plants already.

(iv) TEMPERATURE CONTROL. On two occasions at Jealott's Hill damage has been caused by chilling of the root systems of plants grown under Method I. It is, therefore, advisable to make certain that all water used in preparing solutions is at approximately greenhouse temperature when it is used. Further, whilst little damage is likely to occur in a heated house, in unheated houses (e.g., in autumn when a crop is just finishing off, and cold nights are sometimes experienced) the temperature of the nutrient solution should be maintained at an even figure. No experiments have been carried out maintaining the tank temperature above the mean house temperature.

Discussion. The preliminary experiments at Jealott's Hill, which were confined almost entirely to tomatoes, showed that with this crop, as would be expected, some varieties grow better in solution culture than others. The work is now being extended to other crops.

Advantages claimed for nutrient solution methods are that soil-borne diseases are eliminated, that by judicious use of nutrient solutions the type and amount of growth can be more easily controlled than in soil, and that manual labour for attention is much reduced. On the other hand, it should not be forgotten that if soil-borne diseases are eliminated, it is still possible that new diseases might arise under nutrient solution conditions and that cost of equipment must be taken into

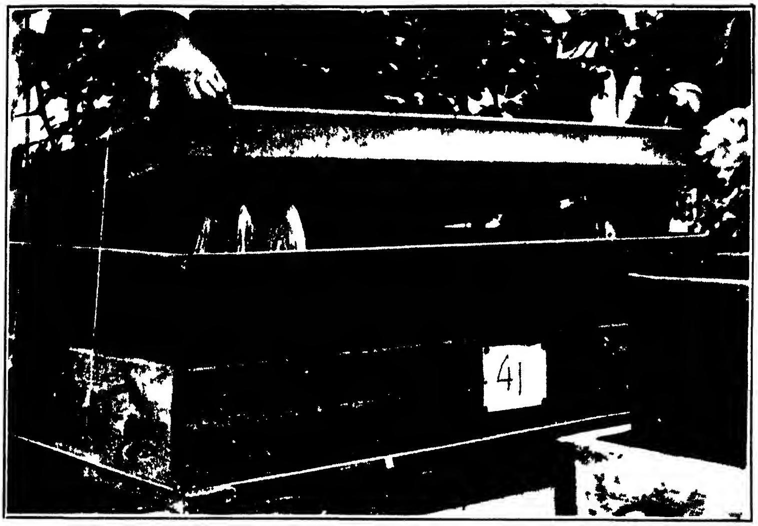

Fig. 6. Root System of Plants grown in one of the Tanks

Fig. 7. Tomato Plants grown in Solution Culture (Method I). Plants set up July 21, photographed September 29. One poor plant developed unsatisfactorily, probably due to delay in roots reaching solution.

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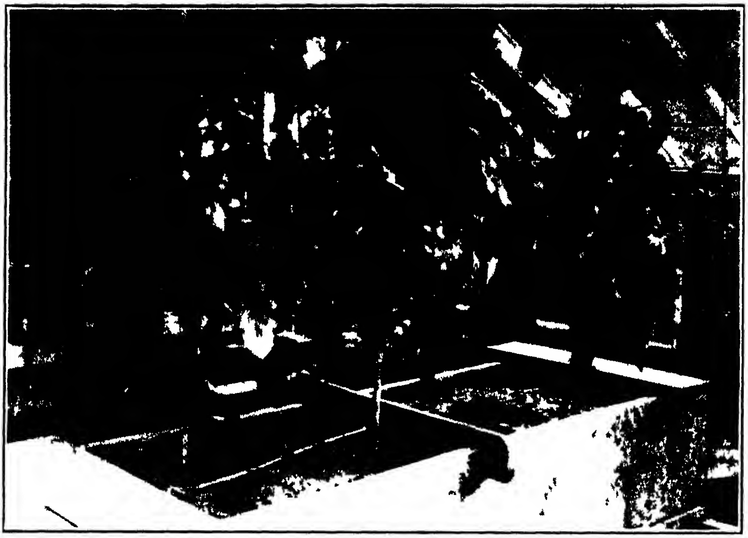

Fig 8 Tomato Plants grown by Drip Culture (Method IV) Dates of setting out and photograph same as for plants in Fig 7 Note reservoir on left and glass tubing carrying nutrient solution and allowing it to drip on the sand medium

Fig 9—Tomato Plants grown in soil for comparison with those grown by Solution and "Drip Culture" Dates for setting up and photograph same as for plants in Figs 7 and 8

account. Further, under current cultural methods, the soil acts as a " buffer " and tends to minimize possible deleterious effects of errors of treatment upon the plant. The experimental stage of the growth of plants by nutrient solution methods cannot be regarded as surmounted.

As has been previously stated and shown by the Jealott's Hill experiments to date, there is as yet no proof that yields obtained in nutrient solution are as good as those obtained under the best soil conditions. On the other hand, these methods, as practical systems of crop production, are still in their infancy, and hasty conclusions should not be drawn. When sufficient experimental evidence has been accumulated, nutrient solution methods will no doubt be of great interest to the amateur and for specialized purposes and later, possibly, to the commercial grower. They will always be of academic interest. It should be remembered that installations of the still culture or drip-culture types can vary in size, from a small window-box for flowers or salads, to tanks of any convenient size for larger undertakings. At the moment, more experimental work must be done before such methods can claim to be suitable for general acceptance, as alternatives to current methods of plant culture on a commercial scale.

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DUNG AND THE ROTATION

F. Hanley, M.A.,

School of Agriculture, Cambridge

Though it is possible to name a few classical instances in which cereals have been grown year after year with artificial fertilizers only and without the use of farmyard manure, few practical farmers would argue that such a practice could or should be adopted generally throughout the country. Rotation of crops and the combination of crops with live stock are two fundamental principles underlying the system of agriculture practised on the bulk of our arable land. Low prices in the livestock industry, and efforts to reduce labour costs on crops by extensive mechanization in some arable districts, have led farmers to try to escape from this association of crops and stock, but such a step is difficult if the fertility of the arable land is to be maintained. Recent troubles abroad, arising from soil erosion, have emphasized the necessity for considering very carefully the cumulative effects of any system of agriculture on the fertility of the land.

In the course of a session devoted to the consideration of present day problems in crop production, during the August, 1938, Meeting of the British Association, several members of the agriculture section emphasized the value of the rotation of crops in general farming practice in this country. During the past twenty years many farmers have departed from the traditional rigid crop rotations which were regarded as of such great importance by previous generations of farmers. This departure from custom has often been no more than an attempt to counter adverse economic conditions, final decisions on the cropping policy in any year being left as late as possible owing to the general uncertainty prevailing within the agricultural industry. Nevertheless, departure from a set rotation may lead to all sorts of difficulties and troubles that can only be avoided by the exercise of care and forethought in planning the treatment of the crops.

A properly planned rotation of crops has much to commend it, not only from the standpoint of the maintenance of the fertility of the soil but also such things as the distribution of

labour and the incidence of disease. In this article, however, it is proposed to deal with the subject solely from the standpoint of manuring and the maintenance of soil fertility.

Manurial dressings are sometimes looked upon as designed to meet nothing more than the requirements of the crops to which they are applied. This view is apt to lead to a misunderstanding of the true relation between soil, manure and crop. The principle that a proportion of the plant food present in some manures remains in the soil and is available for succeeding crops, has long been recognized, as is shown by the provision made for appropriate compensation to an outgoing tenant for manures applied during the later years of his tenancy. In just the same way that the existence of residual plant food from fertilizer applications to previous crops may be expected to assist the growth of subsequent crops, so should the manuring for individual crops be considered in the light of the requirements of the crops that are to follow. When crops follow each other in a definite fixed sequence or rotation the manuring for each crop can also follow a standard scheme and in time it will become virtually automatic, except for minor adjustments in the quantities of nitrogenous fertilizers to meet variations in seasonal conditions.

A decision to depart from a set rotation of crops, however, necessitates reconsideration of the manuring programme. The standard manuring for a crop may not suffice when it is taken out of its usual place in the rotation for it will not then be able to rely on the presence of the reserves of plant food which it usually finds, whilst the manuring which would have been applied to the field for the usual rotation crop may in turn be unsuitable for the proposed crop. As far as artificial manures are concerned, the difficulty is not great and can be adjusted with a little care and thought, but departure from the usual sequence of crops frequently involves an alteration in the fair distribution of the supplies of dung.

Fields that have received no dung for some years are by no means uncommon. The cause often lies in their inaccessibility or distance from the homestead, but it is also frequently associated with changes in the regular cropping scheme. Departure from a rigid crop rotation may sometimes be desirable on economic grounds, e.g., the concentration of certain crops on some particular part of the farm because of more suitable soil conditions or a saving in labour or haulage, but such alteration in the cropping programme should be accom-

panied by reconsideration of the manuring programme, particularly from the standpoint of the distribution of the supplies of dung and other sources of humus over the farm as a whole.

To concentrate the farmyard manure on the fields near the homestead, for instance, may save much time and expenditure on haulage but must inevitably reduce the productivity of the outlying fields, especially on heavy land, unless steps are taken to restore their reserves of organic matter by some other method. Even if the plant nutrients are returned in the form of purchased artificial fertilizers these alone do not create a satisfactory *reserve* of plant food in the soil and even the immediate availability of artificial fertilizers cannot always be relied on, since it is to some extent dependent on seasonal conditions. Further, in the absence of organic matter, soil structure and tilth must deteriorate so that cultivations become less effective and the soil a less suitable medium for root growth. There are, indeed, few people who will not admit considerable benefit to the soil from an application of farmyard manure, other than that which arises from its content of the common elements of plant food. The real nature of this benefit has been the subject of considerable discussion. The mechanical effect on the soil is generally recognized, for a notable improvement in soil structure often follows a good dressing of farmyard manure. Many people also consider that there is some other, and perhaps even more important effect, which, so far, science has not been able to detect. Discovery of the group of substances called " auxins " provided some support for this view, but though these substances can exert profound physiological effects on a plant, such as stimulating the production of roots from cuttings and accelerating the flowering of certain plants, their main effects seem to be on the *method* of growth rather than the final *amount* of growth, and the available evidence does not at present suggest that there is much need to worry about the supply of these substances on the general farm. However, the known beneficial effects of farmyard manure on both soil and crop are ample to justify the high value placed upon it by most farmers, though failure to appreciate the importance of supplementing and correcting its unbalanced content of plant nutrients by the use of a suitable mixture of artificial fertilizers, often reduces, unnecessarily, the extent of the benefits which should follow its use. Reliance on artificial fertilizers alone to maintain the productivity of land deprived of supplies of

organic matter is rarely satisfactory in the long run, whilst reliance on farmyard manure alone is not the most economical manuring practice. For each to produce its fullest effect, farmyard manure and artificials should always be used in conjunction with one another. Even on the highly organic soils of the Fens, where very large responses are obtained to heavy dressings of artificial fertilizers, it is customary to use occasional dressings of dung and there is experimental evidence of the beneficial effects of such dressings on crop yield.

Concentration of farmyard manure on a relatively small area at the expense of the rest of the farm also occurs, sometimes, when a general farmer takes up the cultivation of some special crop, such as fruit or a market garden crop. This is particularly true in the case of crops that occupy the land for more than one season and require annual dressings of farmyard manure. Most of these "special" crops require manurial treatment at a much higher level than the common farm crops and they are in many instances particularly heavy in their demand for farmyard manure. The farmer with a limited amount of money available for the purchase of manures may be tempted, therefore, to reduce his expenditure on manures for his farm crops in order to provide his new venture with the best possible treatment. At the same time he can often only provide the heavy dressing of dung also at the expense of his farm crops. When counting the return from these "special" crops these repercussions on the general farm crops, and on the fertility of the rest of the farm, are not infrequently overlooked. If the new crop succeeds the return may be high by comparison with that from the common agricultural crops, but its cultivation should not be allowed to encroach unduly on the maintenance of the fertility and the general level of farming of the farm as a whole. On the other hand, if these special crops are attempted they must receive liberal treatment so that the wisest course is to restrict them to an area that can be grown without serious interference with the normal treatment of the rest of the farm.

Where land has to be cropped for long periods without applications of farmyard manure, some other method of replenishing the humus content of the soil is essential if the productivity of the land is to be maintained. If some fields are too far away to receive farmyard manure, provision should be made in the cropping scheme to permit the replenishment of the soil

organic matter from some other source. Sheepfolding, long leys and green manuring are all used to supplement or replace the dung cart in different parts of the country. There is little doubt as to the value of the first two of these practices, but considerable uncertainty still exists as to the merits of green manuring. The Woburn experiments with mustard and tares showed first that the successful use of green manuring on light land depends on the proper adjustment of the cropping, and, second, that green-manure crops must be good ones if they are to achieve their purpose. A poor crop is of very little value for green manuring. Tares convert atmospheric nitrogen into a form readily available to crops, but decompose very rapidly in the soil and much of their value is lost unless they can be followed by a crop capable of utilizing the nitrogen rapidly. The rate of growth of autumn-sown crops is too slow for this purpose.

Mustard, on the other hand, decomposes relatively slowly in the soil, but its decomposition requires a supply of nitrate nitrogen which is drawn from the soil. The decomposition of the mustard crop may therefore compete with the succeeding crop for the available nitrogen in the soil. It does, however, serve to carry over available plant nutrients to a time when they can be utilized by some other crop. In addition to this uncertainty regarding the immediate effect of green manuring there is also considerable doubt as to the *duration* of its effect. On some very light soils it is claimed to have been instrumental in maintaining poor land in cultivation, but attempts to measure the effect of green manuring on long-term experimental plots have given very variable results.

The possibility of converting straw into "artificial" farmyard manure on the field itself is of interest on mechanized corn-growing farms. There is little doubt that the rotted straw in farmyard manure is a very valuable constituent and its effect on the soil may be just as important as that of the excreta with which it is mixed, provided it has been properly rotted. It is not so rich in the common elements of plant food as is the excreta but, on decomposition, it forms the humus which is so important in maintaining soil structure. Unrotted straw has long been known to depress the yield of crops when ploughed into the soil by itself for, in a dry season, the straw may not decompose, in which case it merely accentuates the effects of the moisture deficiency by making the soil more open, whilst if conditions are favourable

for the decomposition of the straw, the soil is robbed of its supplies of available nitrogen by the organisms that decompose the straw since cereal straw itself does not contain sufficient nitrogen to meet the requirements of the rotting organisms. The addition of artificial fertilizers with the straw at the time of ploughing-in, however, seems to overcome some of these disadvantages and the preliminary results of long-term field experiments at Rothamsted suggest that this method of dealing with the problem is worthy of full investigation. As with all experiments on the use of organic materials as compared with inorganic fertilizers, however, a long period must elapse before the results can be judged.

FLOORING MATERIALS FOR PIGGERIES

J. N. Dominy, P.A.S.I.

Over the last four years an attempt has been made at the Midland Agricultural College to experiment with the alternative forms of floor construction available for piggeries. It will generally be agreed that the type of material used is of great importance and does affect to a considerable extent the health of the animals lying upon it. It appears that an ideal flooring would possess properties of durability and impermeability with good heat-insulating qualities; whilst a resilient surface is not as desirable in the piggery as it is in the cowshed. Few inexpensive materials will provide all these essentials and it thus becomes necessary in many instances to divide the floor into two sections—the one to provide a hard-wearing surface and the other to provide the insulation. A closed air space has been shown by past experiment to possess good insulating properties, and so in the first stage of the experiment 5 pens were laid in a new "Danish" type piggery erected in 1934, with cavity floors of various types all finished with concrete top surfaces. The remaining pen was laid with solid 4-in. concrete.

Of the five pens, one consisted of 3-in. diameter land drain pipes embedded in 4-in. concrete with a rendering on top of 1 part cement to 2½ parts fine granite chippings (granolithic) with the addition of a waterproofing powder; two other pens were laid with hollow clay blocks on a concrete base and covered with granolithic as before; and the remaining two were constructed of concrete slabs with air spaces formed beneath. One of the latter was a manufactured precast concrete slab laid on a 3-in concrete base and jointed in cement, and the other was a reinforced concrete slab constructed on the site, size 4 ft. × 1 ft. 9 in. × 2 in. thick reinforced with ½-in. diameter steel bars and waterproofed; the slabs were rebated all round the edges and were jointed in cement and supported in raised concrete curbs. During the construction, it was interesting to note that the floors with the air space beneath dried out more quickly, and subsequent experience showed the advantage of cavity construction over solid.

In 1936, a further 8-pen "Danish" type house was erected and the selected construction of the floors was as follows:—

Pen No. 1. Hollow clay block in concrete.
,, ,, 2. Rubber mats on concrete base
,, ,, 3. Plastic rubber flooring on a concrete base
,, ,, 4. Concrete floor with a cork centre.
,, ,, 5. Asbestos cement slabs on concrete base.
,, ,, 6. Asphalte on concrete base.
,, ,, 7. A bitumen emulsion surfacing on concrete base.
,, ,, 8. Land drain pipes surrounded by concrete.

The construction of the hollow block floor in Pen No. 1 was similar to that in the first experiment, with the exception that no waterproofing powder was used and gravel was substituted for granite. The thickness of concrete base was 2½ in. and the finer topping was 1¼ in. On examination 2½ years after the laying, the floor appears in good condition except for a portion adjoining the feeding trough, which is rather rough. As was to be expected, there are more signs of wear with this finish than that with the previous finish of granolithic with waterproofing powder. The surface appears warm and dry.

In the second pen the rubber mats covered an area of 8 ft. × 7 ft. and were set in a shallow well ⅝-in. deep and bedded with a latex jointing composition. These mats proved very satisfactory for the first few months, and then for some reason—probably the deterioration of the jointing or bedding material—the pigs succeeded in raising one corner of the mat. In a very short time a considerable area had been lifted and part of the mat had disappeared. The makers decided not to replace the rubber mats but to substitute a plastic rubber material that had been recently produced. This was laid in September, 1936, and is still in position, although signs of wear are apparent in places, particularly close to the trough. It does, however, form a very warm bed.

Pen No. 3 was laid with another plastic rubber composition flooring overlaying a layer of cork slabs. Difficulty was experienced in mixing and laying the surfacing on top of the cork, and surface cracking quickly occurred. Precast slabs were then substituted, size about 12 in. × 12 in. × 2 in. incorporating a cork base. This material produced a warm, dry surface, but apparently is not sufficiently strong for piggery use, for after signs of wear had appeared in the door-

way and near the trough the pigs succeeded in rooting up portions of the floor at these points.

Since cork is one of the best heat-insulating materials available, it was decided to incorporate it in the floor of Pen No. 4. For cork to retain its high insulating qualities it is essential that it should be dry, and the floor was therefore constructed as follows. Firstly, a 2½-in. layer of concrete was spread to form a base; the top of this was waterproofed with a bitumastic composition (similar to that used in laying wood block floors) and after this had hardened a 3-in. layer of granulated cork was spread. This may be obtained quite cheaply (in fact, in this instance, the cork was obtained from fruit merchants who frequently receive grapes packed in barrels and surrounded by granulated cork). On top of the cork sheets of bitumen felt were spread ready to receive the 2-in. topping of fine reinforced concrete and so prevent the cork and damp concrete becoming intermixed. In this method of construction it might be simpler to use large precast slabs for the top, provided due care is taken to ensure sound joints between the slabs. This type of floor has proved very satisfactory, combining a warm bed with a hard-wearing surface.

Asbestos cement slabs were used in Pen No. 5, bedded in sand on a 3-in. concrete base and jointed in cement. The slabs have dimensions of 6 ft. × 2 ft. 6 in. × 2 in. thick. This finish has so far proved satisfactory with the disadvantage that the surface has worn smooth and so tends to be very slippery. Apart from this, the slabs appear to produce a very suitable floor.

Asphalte, heated and laid on a 4-in. concrete base to form a jointless surface was the finish selected for Pen No. 6. The asphalte was laid to a thickness of about ¾ in. in two equal thicknesses. The surface is now still in excellent condition and is proving quite satisfactory. A black bitumen emulsion was mixed with cement and sand to form the surfacing of Pen No. 7. This particular mixture appears to be a little too soft, and a portion of this top surfacing has entirely disappeared, leaving the concrete base exposed.

The last pen was laid with 3-in. diameter land drain pipes laid and bedded in a 2½-in. concrete base with a further 1½ in. of fine concrete (with a gravel aggregate) laid on top. This floor finish is very similar to that of Pen No. 1, in which hollow blocks are used and the same remarks apply that a

granolithic waterproofed finish will give greater durability, but otherwise the finish provides a dry and warm bed.

Brick pavings, either hollow or solid, were not included as it was felt that such finishes contain too many joints—a possible source of weakness and liable to permit the penetration of liquids to the underside of the bricks, thus setting up unhealthy conditions and making the thorough cleaning of the surface more difficult. It was considered that a far more satisfactory finish would be produced by covering such brick with a topping of fine concrete in accordance with that used in Pen No. 1 so that the whole surface is continuous.

The approximate costs per square yard and per pen of the floor laid complete including any sub-floor necessary were as follows:—

	Approximate Cost per sq. yd		*Approximate Cost per Pen 9ft. × 7ft.*	
	s.	*d.*	*s.*	*d.*
Precast concrete slabs on concrete base	7	6	52	6
Hollow clay blocks on concrete ..	7	0	49	0
Plastic rubber on concrete . .	22	6	157	6
Concrete and cork floor .	8	6	59	6
Asbestos slabs on concrete	11	6	80	6
Asphalte on concrete	14	0	98	0
3-in land drain pipes on concrete ..	7	0	49	0

All of the above prices will, of course, be considerably reduced if the laying is done by direct labour.

Taking into consideration the question of cost, durability, and "warmth," an insulated concrete floor appears to offer the most suitable construction for a piggery floor and has the advantage that should repairs be required the necessary resurfacing can be easily done by farm or estate labour. This assumes, of course, that the concrete is of good quality, and it appears that particular attention should be paid to the portion adjoining the food troughs, where granolithic and/or a concrete surface hardener might be used with advantage. Hardcore may also be used to provide a means of insulation beneath concrete floors, but its efficiency depends on the size and character of the rubble, and it is unlikely to prove as effective as the air space contained in the hollow block or land drain pipe floor. Of the more expensive finishes, the asphalte surface shows the least signs of wear, has been easily cleaned, and is quite satisfactory in other respects.

Precast asphalte blocks were not included, as another pen elsewhere on the farm had been laid with this type of flooring.

The results have not proved satisfactory as the blocks have worn very badly, but now the makers claim to have produced a better type.

So far it has not been possible to compare the feeding and weighing results of pigs in the different pens, nor to obtain significant figures, using simple apparatus, of the relative rates of heat loss through the different floors, but thermal conductivity figures published by Building Research Stations do indicate a wide variation for materials such as concrete, asbestos, and rubber or asphalte, and illustrate the advantages of the use of cavity construction, or of materials having a low rate of conductivity, for constructional work.

HOUGHALL FARM INSTITUTE: THE DEVELOPMENT OF AGRICULTURAL EDUCATION IN DURHAM

J. W. CASSELS, O.B.E., B.Sc. (Agric.)

The agricultural education services in Durham in the years before 1921 were provided chiefly through Armstrong College. These services were, of necessity, somewhat restricted and were rather scattered: e.g., lectures, demonstrations, experiments and advisory work were undertaken by the college authorities; the dairying centre was first situated in Newcastle-upon-Tyne and later transferred to Sherburn Hall; the horticultural and poultry sections had still to be added. The need for a unified centre of all county work became increasingly pressing, resulting in the purchase of Houghall Farm in 1921, and with this event the centralization of county agricultural education work in Durham really commenced. A calendar showing the stages in this development may be of interest.

1921. Purchase of Houghall Farm.
1922. Horticulture and Poultry Stations established.
1924. Training of students (residential) in Poultry Husbandry. Workers' cottages built at Horticultural Station.
1926. Training of students (non-residential) in Horticulture.
1928. Development of Dairying section, by construction of working dairy, byres and piggery.
1929. Training of students in Dairying—residential in Hostel in Shincliffe Village.

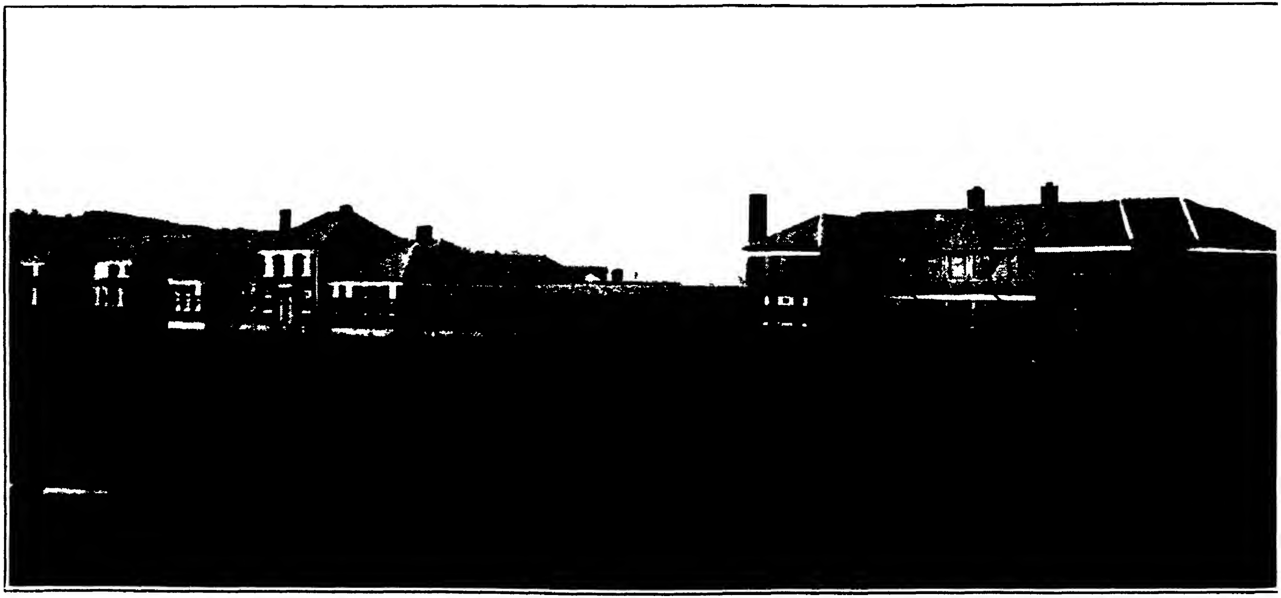
As from October 1, 1932, the administration of the Agricultural Education Service was transferred from the Education Committee to the Agricultural Committee and thereafter the whole service was reorganized on a practical basis with the ultimate aim of establishing a Farm School to provide for more extensive training and for an increased number of students. A great responsibility evolved with that decision and it was regarded as fundamental that modern accommodation and equipment should be provided. Accordingly, representatives of the Durham Agricultural Education Sub-Committee, before deciding on the lay-out of the proposed buildings, made a methodical and careful inspection of existing farm institutes, agricultural colleges, technical institutes and research stations, to examine their instructional, residential and equipment possibilities and their general design.

The new School of Agriculture, formally opened by the Minister of Agriculture on October 20, has given material form to those ideas which appealed most to the representatives and had been found successful by the Heads of the educational centres visited.

The buildings are situated near the main Durham-Stockton road, about one mile from the centre of the City of Durham, with an excellent and generous frontage of lawns, flower beds and shrubs. The main entrance leads to the block containing the administrative offices, committee room, library, lecture rooms and laboratories and includes also the dining room and kitchen. On either side are two colonnades each leading to a hostel, one for the accommodation of 30 young men, the other for a similar number of young women. In each hostel provision is made for resident staff members acting as Wardens, for study-bedrooms and dormitories, bathrooms, a sick bay, and games and common rooms. To the rear of the Women's Hostel is the hostel for the Domestic Superintendent and domestic staff, while to the rear of the Men's Hostel is a large Conference Hall capable of seating 350 people, and provided with stage, anterooms, storage space below floor, cloak rooms and a large all-electric fitted kitchen for demonstration purposes. Between the Domestic Hostel and Conference Hall are two cottages to meet the requirements of a Caretaker-Engineer and a Gardener-Groundsman. Central to the buildings mentioned is an ingenious arrangement for central heating with communal garage for cars directly above. The various units are economically and adequately served with well-constructed roads and paths maintaining the general balance, which is an important feature of the whole structure.

The laboratories are designed not only to accommodate students for instructional purposes but also for the investigation of the problems of the agriculturist in connexion with the county advisory services. The Conference Hall, which is equipped with a film projector, is an ideal building for lectures, or any important agricultural function involving large attendances. Hard tennis courts and a large playing-field indicate that work is to be leavened with play in the lives of the students.

The Farm extends to 350 acres, of which 150 are arable, and the whole provides for "mixed" farming practice. It carries a large dairy herd consisting of pedigree Ayrshires and grading up Shorthorns and a proportion of cattle for beef



Houghall Farm Institute—The New Buildings

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production, all of which are Attested and abortion free. Pigs are confined to the Large White Breed, pedigree and T.T.; sheep are represented by Half-bred and Mule Ewes crossed with Oxford and Suffolk rams to produce lambs for fattening on roots. Clydesdale horses and a tractor provide for cultivation and other farm work. Trials are conducted with grass land, manures, cereals, roots and in livestock feeding.

The Dairy has complete modern equipment to deal efficiently yet economically with the high grade of milk produced on the farm, which is disposed of for liquid consumption. In addition to milk produced on the farm, a quantity is obtained daily from outside sources for the manufacture of cheese and butter. It will be seen, therefore, that facilities exist for the training of students in every branch of the dairy industry: for those who desire more detailed knowledge to help at home on the farm or small-holding; for those who desire to obtain situations as dairy maids at farms, etc., and also for those who desire practical training prior to proceeding with more advanced courses of tuition in preparation for the National Diploma in Dairying.

The Horticultural Station, extending to approximately 20 acres, is devoted to the cultivation of general garden produce. Top fruit (apples, pears and plums), raspberries, strawberries, red currants, black currants, gooseberries, as well as practically all types of vegetables, are cultivated. Tomatoes, flowers, cucumbers and early vegetables are catered for in the glasshouses (three houses with a propagating house). A "cold" house constructed on the modern Dutch principle covers, approximately, half an acre — this house can be completely dismantled and the "lights" so obtained utilized as cold frames for the production of early vegetables. It can thus be seen that, excluding specialist work, the main types of garden produce are dealt with. A Weather Station has been in existence at the Horticultural Station for the past twelve years, and accurate records of air and soil temperatures, rainfall and sunshine together with readings of winds, visibility and general weather conditions are supplied monthly to the Air Ministry.

The Poultry Station is now firmly established on a new site, with new stock and equipment. The foundation stock consists of Rhode Island Reds, White Leghorns, White Wyandottes and Light Sussex, with the addition of turkeys (white), Aylesbury ducks and geese. Free range, intensive, semi-

intensive, fold units and laying battery systems are in operation so that almost every possible branch of poultry husbandry is provided for. Hatching and rearing for breeding purposes, egg production and production for table purposes receive equal attention and special tuition is also provided in the plucking, trussing and dressing of all classes of table poultry. Students have the additional advantage of observing operations on the Egg Laying Trial ground which adjoins the Poultry Station. The prospective backyarder, small poultry farmer, or the commercial poultry farmer, are equally accommodated.

The courses of instruction are practical and every student will come in contact with the actual work of his or her department day by day. Skill in such work and devotion to duty will be regarded as of the utmost importance because it is intended that a Houghall-trained student will be able to satisfy an employer's reasonable expectations should that student desire to earn a livelihood in agricultural work. The training is planned to increase the efficiency of sons and daughters of those connected with the land, to attract people from outside into the industry if they have the inclination and will to persevere; and to furnish a background for the student, who intends subsequently to enter upon an academic career.

The Centre, as a whole, has, as an ultimate aim, the achievement of results which will appeal to members of the agricultural community. It exists to demonstrate successful practices and progressive ideas, to link up the findings of the research worker with the efforts of the producer and to evolve a new generation of land workers equipped to carry on the struggle of earning a livelihood from the soil. It must prove itself an economic asset to the great agricultural community it is intended to serve and its example must be its precept.

NUTRITION AND REPRODUCTION

CHARLES CROWTHER, M.A., Ph.D.,
Harper Adams Agricultural College

The maintenance of regular and healthy reproduction coupled with a sound breeding policy is clearly essential to the development of successful animal husbandry. Until recent years the major causes of reproductive troubles were commonly sought in the field of disease, but conclusive evidence is now available that in very many cases the basic causative factor primarily arises from faulty nutrition. The effects of such factors, moreover, are not necessarily exercised directly upon the sex organs, but may affect their activities only indirectly through the establishment of abnormalities in other parts of the body whose healthy co-operation is essential to the optimum working of the reproductive processes.

That general bodily condition may react upon reproductive efficiency has long been known to observant breeders. Extremes of leanness and fatness must be avoided. The half-starved animal, whether male or female, is likely to be slow in arriving at puberty and of low breeding efficiency thereafter. The female in such condition may for a time produce healthy offspring, but only through incurring a strain upon her body that may soon cause the production of dead or weakly offspring and permanent damage to herself. The underfed male will show his weakness in reduced number and vigour of the sperms. At the other extreme, the detrimental effects of over-fatness are revealed in the widespread experience that in both sexes the maintenance of animals in " show " condition for more than short periods is generally accompanied by low fertility.

Under-nutrition may arise from a general deficiency of energy supply or from deficiency of one or more of the specific essential factors, such as vitamins or minerals, or from the combined effects of more than one deficiency, and the nature of the reaction upon reproductive activity will vary with the character of the nutritional defect. In the female an effect that seems to be common to all types of nutritive deficiencies is a disturbance of the oestrous cycle, leading to irregularity or in severe cases to actual cessation.

Energy Requirements. The minimum energy requirement for reproduction in the female is obviously that represented by the energy stored in the form of new tissues in the growing foetus and its membranes, in the enlargement of the uterus and the development of the mammary glands. To estimate the actual energy requirement, however, this minimum must be increased, since even under the most favourable conditions it is hardly possible for the whole of the available energy that is applied to the reproductive process to be stored up in the new tissues. In other words, we must provide not merely for the material produced but also for the work of reproduction. Each of these items, which together form the total energy requirement, will vary at different stages of the gestation period.

That the rate of storage of energy in the foetus and other uterine products rises steadily as gestation progresses has been well demonstrated in studies with young sows at the Illinois Agricultural Experiment Station. In these studies it was found that with a sow producing a litter of 8 pigs the daily storage of energy rose from less than 2 Calories in the first week to 272 Calories in the sixteenth week of gestation. Similar increases were also recorded in the storage of protein and mineral elements. For the whole period the average daily storage of energy was 104 Calories, and assuming that the additional storage of energy in the growth of the mammary glands would not exceed 10 per cent. of this figure, an estimate of an average daily requirement of 115 Calories of net energy to cover the specific needs of reproduction was arrived at. When this is compared with the net-energy requirement for maintenance of gilts of the weight used in these studies (200 lb.), which was put at 2,000 Calories, it will be seen that the extra energy requirement of the in-pig gilt as compared with the " empty " gilt amounts to no more than 5 or 6 per cent., and even at its highest point in the closing week of gestation when it may have risen to 300 Calories, this represents but a 15 per cent addition to the basic maintenance requirement. If these energy figures be converted into terms of the corresponding weights of digestible nutrients, the ratios will remain much the same and we may conclude that as far as extra energy supply is concerned the additional requirements for pregnancy of the sow are trivial in the early stages of gestation and at no stage are likely to exceed 20 per cent. of the basic maintenance requirement. With longer

period of gestation of the cow, the extra energy requirement in proportion to the size of the animal is probably even smaller.

These computations leave out of account, however, the bodily condition of the mother herself, and if this is low at the onset of pregnancy it will clearly be advisable to feed on a more liberal scale until the desirable state of bodily fitness has been attained. This is all the more important since some draft upon the reserves of the body is almost certain to be made, even with abundant food supply, to sustain the milk flow subsequent to parturition, when it reaches its maximum level.

A further point to keep in mind in connexion with these estimates of food (energy) requirements is that they assume that the ration is adequate with regard to all other essential factors. Should there be a deficiency of protein or phosphorus, for example, then probably a greater amount of food will be required to secure the same level of storage of energy. The nature of the ration requires separate consideration, therefore, apart from the question of energy supply.

Protein Requirement. Bearing in mind that the dry substance of the foetus and other products of gestation is rich in protein, it follows that the trend of protein storage with advance of gestation will be similar to that of energy, small in the early stages and rising to a relatively high level at the end. Thus, in the Illinois studies referred to above the daily rate of storage of crude protein rose from 0.5 grm. in the first week to 33 grm. in the sixteenth week. This is a far smaller relative increase than that found in respect of energy storage, which is to be expected since, as the foetus develops, an increasing proportion of the retained energy is stored in the form of fat.

Over the whole period the average rate of protein storage was 14 grm. per day,* which may be raised to 16 grm. to allow for protein stored in the increase of mammary gland. As to how much digestible protein should be included in the food supply to provide for this storage, this will depend upon the "biological value" (or "quality") of the food protein. If this be assessed for common types of rations at 50 per cent., the average daily requirement of digestible protein in the food

* This figure agrees well with that of 12·5 grm obtained by Evans in experiments at Cambridge.

to secure an average storage of 16 grm. would be 32 grm. Similarly, to provide for the 35 grm. daily storage in the last week of gestation about 70 grm. of digestible food protein will be needed. According to American estimates the pig of 200 lb. live weight requires for maintenance about 100 grm. of protein per day. German estimates give the much lower figure of 60 grm., but even taking the higher figure it will be seen that the additional requirement for food protein imposed by pregnancy is no less than 32 per cent. on the average of the whole period and 70 per cent. in the closing stage of gestation. Although, therefore, the total food requirement during pregnancy as indicated above may be but little increased, the protein requirement is substantially increased and therefore the composition of the ration must be adjusted, by reducing the cereal fraction and increasing the protein-concentrate fraction, to ensure the necessary increase of protein supply. The same principles apply to other classes of live stock, but where the rate of development is slower the relative increase of protein supply required will be less. Thus, Maynard estimates that the maintenance requirement for protein for the cow may be increased during gestation by an average of 17 per cent. over the whole period, or 40 per cent. in the closing stage.

These are probably under-estimates of what is *desirable* since here again, as also for energy storage, regard should be had to the desirability of enabling the parent to store up a reserve of protein in her body, apart from the bare needs for reproduction, in order to provide some insurance against the drain to which she may be exposed later when the heavy demands of lactation have to be met.

Vitamin Requirements. Despite a considerable amount of research, the precise significance of vitamin supply for reproductive efficiency is still not clearly defined. Only for vitamins A and E does there seem to be a clear case for postulating that the maternal diet must include extra amounts to cover any specific requirement for reproduction. For the welfare of the mother herself the whole range of vitamins may be of importance, and certainly the A and D vitamins, whilst a liberal supply of these vitamins to the mother makes possible the accumulation of reserves in the foetus, which will be valuable in the early stages of post-natal life. That there is a specific requirement for vitamin D for reproduction would

seem probable, but conclusive evidence as to this has not yet been obtained, especially as regards farm animals.

That an adequate supply of vitamin A is essential for efficient reproductive activity has been established for both sexes. In the male a deficiency of this vitamin quickly induces a marked lowering of fertility. In the female the first sign of vitamin-A deficiency is commonly the development of irregularity of oestrus, which ultimately may cease entirely if the vitamin deficiency is very severe. If fertilization takes place, the gestation may be prolonged and terminate in difficult parturition; the placenta will often be abnormal and the incidence of foetal death and resorption, or of abortion, will be increased. These effects arising primarily from placental injury are said to differentiate cases of vitamin-A deficiency from foetal death due to deficiency of vitamin E which is occasioned more directly by defects in the foetal tissue itself. The diagnosable symptoms of vitamin-A deficiency vary somewhat according to the species of animal and the severity of the deficiency.

Little is known as to the minimum requirements of vitamin A for reproduction, but there is evidence that they are at any rate greater than those for maintenance. The simplest practical safeguard against deficiency of this vitamin lies in the supply of leafy greenstuffs, either fresh or artificially dried. Where this is not available, or with animals, such as the pig, that can only digest relatively small quantities of roughage, the inclusion of yellow maize in the ration will be helpful. There is evidence, however, that pig-feeding rations, even when relatively large proportions of yellow-maize are included, are often barely adequate in supply of vitamin A unless either a store of the vitamin has been built up in the animal during the pre-natal and early post-natal periods, or some additional good source of the vitamin, such as greenstuff or cod-liver oil, is added to the ration. As to the former alternative, experiments at Cambridge and elsewhere have demonstrated that only a very small fraction of the vitamin A of the maternal food-supply can be stored up in the offspring, so that with a rapidly-growing animal like the pig the most liberal pre-natal supply of the vitamin to the mother will not for long safeguard the offspring against deficiency in the post-natal food supply.

The basic need for vitamin E for reproductive efficiency has been demonstrated, but there is little evidence as yet that

breeding troubles due to deficiency of this factor are met with more than very rarely in farm practice. Nor, indeed, is it to be expected that this class of trouble would be often met with in view of the supply of the vitamin in greenstuffs and the germ of cereal grains. Should the exigencies of flour milling, however, lead to a greater removal of the germ from the " offals " than is as yet customary, the possibilities of vitamin-E shortage in breeding stock kept indoors with little or no greenstuff or unmilled grain would need to be examined.

Mineral Requirements. The general importance of an adequate supply of mineral elements for the building-up of the developing foetus is obvious. Calcium and phosphorus are essential for bone formation, alkalies for the proper functioning of the body fluids, iron for the production of the necessary haemoglobin in the blood, iodine for the efficient working of the thyroid gland, and other mineral elements for other specific purposes. There is little possibility with these mineral requirements of off-setting a deficiency of one element by a surplus of another of similar character, say of potassium by sodium.

For the purposes of energy supply, carbohydrates, fats and proteins are to a large extent mutually replaceable, but in regard to mineral supply the functions in the body of each particular element are largely specific and can therefore only be met by the supply of that element in the food.

Judged in terms of quantity the most spectacular mineral requirement for growth, and therefore for reproduction, is that for calcium and phosphorus, since these form so large a part of the structure of the bones. The magnitude of this requirement explains also why deficiencies of calcium and phosphorus are more frequently the cause of trouble in practical animal husbandry than any other form of mineral shortage.

The direct incidence of deficiency of calcium or phosphorus on reproductive efficiency has been conclusively demonstrated by experimental work in many parts of the world. As an example, the classic work of Theiler and his associates with cows on the phosphorus-deficient grazing areas of South Africa may be quoted. When the grazing was supplemented by bone meal or other phosphorus concentrates the calf crop was about 60 per cent. greater than when no such supplement was given. Similar effects upon fertility also accompany calcium deficiency, which causes an increase in the number of progeny born dead or weakly.

Over the world in general, calcium deficiency is probably

less widespread than phosphorus deficiency, but there are many areas, including a large part of Britain, in which the position is reversed. In housed animals fed mainly on grain and other concentrated foods it is also more often the supply of calcium than of phosphorus that needs special attention.

The effects of shortage of these elements on reproduction are the more insidious through the gradual character of their development, since for a time, which may be prolonged, the deficiencies of the food may be made good by depletion of the supplies of calcium and phosphorus in the maternal skeleton. Even with a continuous deficiency, therefore, little effect may be apparent at the first, or even at the second pregnancy, and when eventually it does appear the general tendency will be to look for the cause in some recent change of diet or treatment rather than in the long-continued (but unsuspected) dietary mistake. The unwisdom of allowing a drain upon the mineral reserves of the maternal body during the gestation period becomes actual folly when it is remembered that this period is followed by the period of milk production, in which for a time some further depletion of the maternal mineral stores is almost inevitable even with a liberal supply of minerals in the food.

It is difficult to arrive at reliable data for the calcium and phosphorus requirements of the pregnant animal since these must cover not only the amounts actually stored in the contents of the uterus but also the maintenance needs of the mother, who should indeed receive more than this in order to enable her to build up reserves in her bones with which to meet the subsequent strain of lactation. As to the actual storage in the growing foetus, the data obtained in the American studies with pigs referred to above indicated that about 95 per cent. of the calcium and 90 per cent. of the phosphorus were stored up in the second half of pregnancy, and no less than 60 per cent. and 50 per cent. respectively were stored up in the last three weeks. It would seem, therefore, to be more particularly in the later weeks of pregnancy that attention should be given to the adequacy of the supply of these two mineral elements.* The same applied to the

* On the other hand, results obtained by Evans at Cambridge indicated that, even with a liberal supply of calcium in the food, the enhanced requirements of the foetus in the later stages of pregnancy were largely drawn from the maternal reserve, so that the wiser plan may be to give calcium liberally in the first half of the gestation period in order to ensure that this reserve is fully developed when it is needed, rather than to rely upon direct assimilation from the food at the time when the need is greatest.

storage of iron except that in this case the rate of increase of storage increased more gradually from start to finish, although about 80 per cent. of the total was stored in the second half of the period and nearly 40 per cent. in the last three weeks.

In other American studies the conclusion was reached that the ration of pregnant sows should contain not less than 0.4 per cent. of calcium, or say 0.3 per cent. rising to 0.5 per cent., with rather less phosphorus. For gilts the proportion would need to be a little higher to cover the gilt's own growth requirements.

As regards ruminant animals, with their longer period of gestation, the daily requirement of minerals is less in proportion to body size. Thus, in the ewe it is estimated that 0.2 - 0.35 per cent. each of calcium and phosphorus in the daily ration will be adequate. In the cow a still lower proportion, say 0.15 - 0.25 per cent., is probably adequate for maintenance and reproduction, but here the estimation of the requirements for the needs of production is complicated in the first pregnancy by the simultaneous need for the purposes of growth of the heifer, whilst in later pregnancies a still greater complication arises if, as is usual, milk production is continued through the greater part of the new gestation period. In practice, therefore, it is hardly possible or indeed necessary to discriminate between the requirements for the various needs which together make up the total requirements. A rough standard which, judged by American data, will probably not be far wide of the mark for average conditions, can be arrived at by taking a minimum requirement of 0.10 per cent. each of calcium and phosphorus in the dry matter of the food for the "empty" dry cow, increasing this by 0.07 per cent. for the dry, in-calf cow, and by a further 0.07 per cent. for each gallon of milk. On this basis, the cow of average size, in-calf and giving 2 gal. of milk daily would need in her daily ration about 0.3 per cent. each of calcium and phosphorus.

The requirement for other mineral elements need only be dealt with briefly since it is probably only rarely in ordinary breeding practice that actual deficiency with regard to them arises. It is true, for example, that the need of the pregnant animal for iron is probably twice or thrice as great as the maintenance requirement, but unless the animal is kept under highly artificial conditions, such as are for many reasons undesirable for breeding stock, it is unlikely that even this enhanced iron requirement will not be met by the ordinary

food supply. The risk is certainly greater with a prolific quick-growing species like the pig than with slower-growing species, and for the in-pig sow, without making any nice calculations as to iron supply, it may be worth while to enrich the dietary slightly with iron on the off-chance that some little of it may be stored in the young pigs, which thereby may be better equipped to avoid the post-natal risks of anaemia.

The only other mineral element that perhaps needs special mention is iodine, but as to whether deficiency of this element is likely to be at all common in practice it is difficult to obtain clear guidance. Since iodine is an essential factor in the activities of the thyroid gland, which include an intimate influence upon the processes of reproduction, it is obviously very important that there should be no risk of shortage of iodine in the breeding animal. The evidence from practical feeding experiments with iodine supplements to ordinary rations is very conflicting, and certainly does not as yet warrant any general recourse to iodine supplements for breeding stock. A deficiency of iodine so pronounced as to affect reproduction seriously will almost certainly establish a goitrous condition in the parent animal, and where such condition can be diagnosed an increase in iodine supply is clearly required. In the light of existing information we are inclined to agree with Maynard that " there is no conclusive evidence that the feeding of additional iodine to breeding animals is helpful except in the specific situations where goitre is occurring, or that it has any benefits other than goitre prevention. . . . Since the danger of over-dosage with iodine is a real one, it seems wise to restrict its use to the prevention of goitre and related troubles in areas where they otherwise occur, until positive benefits for other purposes have been clearly proved."

Finally, a word may be said as to the possible need for a supply of salt to the breeding animal. No information is available on this point, but since there is evidence that deficiencies of salt supply may arise in respect of quick-growing animals like the pig and chicken it may perhaps be as well to keep in mind a similar possibility in regard to pre-natal growth, although in this case the maternal body will probably provide an adequate regulator of supply to the uterus, even on a salt-deficient diet. It is plain commonsense, however, that a deficiency which can be foreseen should be avoided.

SUGAR BEET: MANURING AND CULTIVATION

At a Conference convened by the Agricultural Committees of Dorset, Hants and Wilts, held at Salisbury on September 23, to consider the problems of sugar-beet growing in "the Outside Areas," some of the problems of manuring and cultivation were dealt with in addresses by Mr. A. W. Ling (University of Bristol), and Mr. F. Rayns (Director of the Norfolk Agricultural Station), summaries of which are given below.

MANURING

A. W. Ling, M.Sc., F.I.C.

The correct cultivation of land for sugar-beet is far more important than attempting to argue whether or not it is better to apply 2 cwt. or 2¼ cwt. per acre of sulphate of ammonia for the crop. No amount or kind of fertilizer will undo the harm which is bound to ensue from bad or inadequate cultivations. No top-dressing is going to overcome the lasting effects of a bad seedbed. Yet so often we expect fertilizers to put everything right. They will not do so, and the fertilizer gets the blame for something for which it is in no way responsible. To-day, fertilizers are far too often used as excuses for bad management and far too much is expected of them. Correct manuring of the sugar-beet crop is essential to success, but a good paying crop depends 75 per cent. on good cultivation and management and 25 per cent. on well balanced manuring.

Some 12 or 13 years ago, when the post-war sugar-beet campaign was forging ahead, a very large number of sugar-beet manurial trials were carried out in the counties of the Bristol Province. These trials extended over a number of years and embraced almost every type of soil to be found in the western area. It is a pity that the acreage of beet grown in our surrounding counties has declined, largely because there is no factory nearer than Kidderminster, because there is not the slightest shadow of doubt that the beet crop grows extraordinarily well in this area, producing both a high yield of beet per acre, with a sugar content well above the average.

Liming. So much has been written and said about liming, that it is surprising to find even to-day patchy crops owing to soil acidity. The Land Fertility Scheme is intended primarily to apply to grass land, but it is, of course, not restricted to grass, and sugar-beet growers should take full advantage of the Scheme in order to correct the acidity of their arable land, but it should never be assumed or taken for granted that a soil is either deficient in or contains a good reserve of lime. It should be tested, and this should be done through the County Agricultural Organizer of the county in which the land is situated. It costs nothing to the farmer. It should always be remembered that sugar-beet is one of the crops most seriously affected by soil acidity.

With regard to the type of lime to apply to acid land, provided the correct proportions are used, it does not matter a great deal what kind it is. Thus, if it is reported that a certain soil has a lime requirement of 2 tons per acre, it means that two tons of ground limestone, or chalk, (i.e., carbonate of lime) are required. If, instead of using ground limestone, it is thought more desirable to use ground burnt lime, or quicklime, then 1 ton will suffice. Again, hydrated lime may be available at an economic price, in this case 1⅓ tons will be required—or to put it all in another way, 1 ton "pure" quicklime equals 27 cwt. hydrated lime or 36 cwt. carbonate of lime (i.e., ground limestone unburnt). With regard to the many waste limes which are now appearing on the market, the quantity to apply must be determined by the lime content of the sample.

The secret of liming for the beet crop, or, in fact, all arable crops, is evenness of distribution. There is no hard and fast rule as to the best time to apply, but generally speaking, it may be taken that for beet, waste limes and carbonates are best applied in the back end, particularly if these substances are lumpy, and ground burnt lime on top of the last ploughing for the crop in the spring. In any case, lime should not be ploughed in deeply—it gets down quite quickly enough of its own accord.

The Use of Farmyard Manure. Good farmyard manure properly applied and used in conjunction with other fertilizers is still the best manure we have, but unfortunately, there is far too little available for use on arable land. Sugar-beet can be, and is, grown quite well without farmyard manure, but for

how long this humus-exhausting process can be continued, particularly on the lighter types of soil, which are suitable for sugar-beet, it is difficult to say. It is important to remember that farmyard manure is relatively costly and an application of fifteen loads per acre costs somewhere in the region of £2 per acre. Further, farmyard manure is not a balanced fertilizer, and, whatever quantity is used, phosphates and potash, together with a quick-acting nitrogenous manure, are also essential.

Artificial Manures. Artificial manuring is essential to the securing of a full crop, and it is only a full crop with a good yield of tops as well as roots that will pay. Nitrogen is essential for rapid healthy growth, phosphates for root development and potash for sugar formation and for increasing resistance to disease. Actually, the growers' objective should be the heaviest possible crop; he cannot do much about increasing sugar content. In any case, in the West Country sugar content is generally about $1\frac{1}{2}$-2 per cent. above the standard $15\frac{1}{2}$ per cent. Each soil must be considered on its own merits as regards manurial requirements, and here again soil analysis is valuable in that it tells the grower whether or not his soil is deficient in phosphate and potash, or how the balance between the two stands. This is important, because although a soil may contain a large reserve of phosphate and a medium supply of potash, potash deficiency may exist on account of lack of balance between the two. The balance of "available" potash and phosphate that one likes to see is potash 4: phosphates 5. Many of the Wiltshire chalk arable soils are far from balanced in this respect, being very high in phosphates and relatively low in potash. In this connexion, a more liberal and frequent use of potash is definitely essential.

The following table of manures is given as a rough guide. Each soil has its own peculiarities, and each must be treated as an individual. In any case it is a golden rule not to stint the manuring. If the manures are cut down by half, there may be a saving of about £2 per acre, i.e., the price of about one ton of beet—an adequate application of a well balanced manure may make the difference of several tons of beet per acre, also a higher yield of valuable tops and of the subsequent crops—a full dressing of fertilizer is worth far more than twice half a dressing.

The following is a suggested guide to manuring, per acre of medium soil, with dung:—

2–2½ cwt. sulphate of ammonia. (Part may be as nitrate of soda).
2–2½ cwt superphosphate (30 per cent)
1 cwt. steamed bone flour.
2½ cwt potash manure salts (20 per cent)

with the addition of 1½ cwt. sulphate of ammonia, or nitrate of soda as a top dressing
or 1½ cwt. nitro-chalk, as a "side" dressing.

For those not wishing to mix their own fertilizers, a compound manure with 12½ per cent. nitrogen, 12½ per cent. water-soluble phosphoric acid and 15 per cent. potash is suggested. C.C.F. No. 1 meets with these requirements, and it should be applied at the rate of 4-6 cwt. per acre according to the quality and type of dung used. On the lighter soils, a compound manure with slightly less nitrogen and phosphates, but more potash, is advisable. Excellent results have been obtained in some parts by replacing part of the nitrogen and potash with Chilian potash nitrate at the rate of 3 cwt. per acre. Also, on acid soils, basic slag at 5-6 cwt. (30 per cent.) per acre in lieu of "super" and steamed bone flour has given remarkable results.

Deficiency Diseases. Two diseases have been studied during recent years—Heart Rot, attributed to boron deficiency, and another caused by manganese deficiency.

HEART ROT. This appears to be more prevalent in very dry seasons, and also on soils that may have been over limed. The work of Hanley and Mann* in Norfolk has shown that the disease can be prevented by the use of borax in the powdered form at the rate of 21 lb. per acre. Even distribution is essential, and whilst the borax can be mixed with the other fertilizers (resulting in a slight loss of ammonia) and applied with them, it is better to mix it with sand up to 1 cwt. per acre, and carefully broadcast during the early stages of the seed-bed preparation.

MANGANESE DEFICIENCY. A disease due to manganese deficiency has been reported by Morley Davies in the West Midlands. It occurs quite frequently on light soils, rich in humus, e.g., reclaimed heaths which have been made alkaline by excessive liming. Good control of the disease has been obtained from the use of manganese sulphate at the rate of

* See this Journal, April, 1936, pp. 15–23

60 lb. per acre applied with the other manures. Also, as basic slag contains a reasonable percentage of manganese, the use of this fertilizer is recommended on soils of the type described. In experimental work, it has given good control of the trouble.

CULTIVATION

F. Rayns, M.A.

In recent years, the sugar-beet acreage of Norfolk has more than equalled the combined acreages of mangolds, swedes and turnips. Farmers have therefore fitted the crop into their rotation and made it the pivot of their farming. When this is done, the supply of home-grown feed for cattle, and the possible effect on the condition of the holding and upon the labour, become matters of importance. When roots are completely replaced by sugar-beet the by-products available for feeding, namely beet tops, beet pulp and molasses, do not quite equal the food value obtained from an equal area of mangolds.

Feeding trials have proved conclusively that beet pulp is a safe food for all classes of stock, equalling roots when fed in the proportion of 1 to 8. A ton of fresh beet tops has been shown to be equal in feeding value to a ton of swedes. Thus, the sheep feeders in the Eastern Counties make use of beet tops until the early part of February, secure in the knowledge that an acre of beet tops is approximately equal in feeding value to half an acre of swedes. The acreage of white turnips hitherto used for sheep feeding before Christmas, has in consequence been considerably reduced.

Experiments over three rotations at the Norfolk Agricultural Station show that beet tops used for green manuring affect at least the next two crops in the rotation. In a four-course rotation, the successive average increases were 8.3 bushels barley, 4.3 cwt. hay per acre. In practice, however, stock feeding methods are changed, but the number of stock kept need not be reduced, nor the supply of farmyard manure depleted.

Hand labour is required chiefly for singling and harvesting sugar-beet, but whether it is necessary to employ extra men depends upon the proportion of sugar-beet in the root shift. In districts where labour supplies are short, it is inadvisable to grow more sugar-beet than the permanent men can handle. On piece work, one man regularly singles, and then hand-hoes up to 8 acres of sugar-beet in East Anglia, and will pull,

knock and top an equal area during the three months allowed for harvesting. Generally it is not until sugar-beet occupies rather less than half the root area on an East Anglian arable farm that extra labour must be employed, provided that the regular men are prepared to work overtime. In any case, however, it is as well to try to reduce the work of the men by planning the crop to make their efforts more effective. Thus, it has been shown that plants left in bunches for seven days before singling do not take any harm, as they would do if left in the continuous row. The period over which the crop may be singled, therefore, is increased if it is bunched first and singled within seven days instead of being bunched and singled in one operation. Similarly, although the yield of the largest plants is greater than that of the smallest, the compromise left by the men yields so closely to that of the best plants that it is not worth while slowing up the work with a specific instruction always to select the most vigorous plants. And, although it does reduce the final plant population a little to start singling too early, it is much better to start too early than end too late. Moreover, the higher the plant population the longer the time taken in singling it. Plant populations should therefore be no larger than is absolutely necessary, although the disastrous consequences of a thin plant cannot be overstated.

Something, too, can be done by the user of machinery to gap the plant, and the method known as cross-blocking is worth considering by beet growers with suitable equipment. For good results from cross-blocking it is necessary to have almost an ideal braird and if possible to arrange for the crop to be spaced equally in each direction. The method requires considerable skill on the part of everyone, otherwise damage to the plant may result. In districts where it has been tried, it has resulted in reducing the piece-work costs. Reductions in yield, however, cannot be tolerated from cross-blocking, and if the method is to be successful the yield of the crop must at least be as high as that obtained from hand spacing. With care this should be possible.

THE CONTROL OF CABBAGE ROOT FLY

[*Delia* (*Hylemia*) *brassicae*, Bouché]

D. W. WRIGHT, B.A.,

Horticultural Research Station, School of Agriculture, Cambridge

Of the insect pests of plants of the cabbage tribe, none is more regular in occurrence or causes greater destruction than the Cabbage Root Fly. It is prevalent not only throughout Great Britain but also in Europe and North America. From time to time, several methods for its control have been advocated in this country, but they have not proved themselves sufficiently reliable or practicable under field conditions to have come into general use. In fact, comparatively little is done to check this pest, and it is still annually responsible for heavy financial losses. It is most prevalent on those holdings where frequent cropping with brassicae is practised, and for this reason is usually more severe in gardens and small holdings than in the field.

Host Plants and Damage. In Great Britain the fly appears to confine its attacks to plants of the natural order *Cruciferae*. Of these it is most partial to and causes most damage on the various cultivated varieties of brassicae.

Damage to the plant is caused by the larval or maggot stage of the fly and not by the adult fly, which is said to feed on water and sugary solutions obtained from various flowers. The maggots, although occasionally found in the aerial parts of the plant, most commonly attack and cause greatest damage when infesting the root system. When heavily attacked, all portions of the plant below ground are completely debarked and death therefore soon follows. Such plants are easily pulled out of the ground, their root system having been reduced to a black, decaying, " rat-tailed " strand. Less heavily attacked plants often form adventitious roots just below the soil level, and may succeed in re-establishing themselves. The yield and quality of the produce from such plants is, however, always adversely affected.

Although most brassica crops are susceptible to this pest, early cauliflowers probably suffer most. Even a slight attack, if weather conditions are unfavourable for rapid plant recovery,

induces the young plant to button. The resulting premature heads are usually too small to market. Cauliflowers show little resistance to heavy root infestation and rapidly succumb.

Cabbages, Brussels sprouts and broccoli are also often heavily attacked, but kale, turnips, swedes, kohl rabi and radishes suffer less frequently. Heavy attacks on the latter, however, do occasionally occur, the writer having recorded two cases during June of this year (1938). On seeding swedes growing on the Cambridge University Farm a 100 per cent. attack was recorded, while a salad crop of turnip-rooted radishes at the Horticultural Research Station was damaged to the extent of 50 per cent. In both cases the bulbous portion of the plants were mined by the larvae and the crop spoiled.

In late summer and autumn, maggot injury to the roots of brassica plants is usually much less common, but maggots are then often found mining in the aerial parts of the plant. This appears to follow a significant change in the egg-laying habits of the female flies, which, instead of depositing their eggs solely in the soil about the stem base, lay a certain proportion on the stem itself and about the top of the plant. The resulting larvae mine in the leaf mid-ribs, the stem and, with cauliflowers, in the curd as well. In cauliflowers being grown for seed this form of attack is sometimes very serious, for a bacterial rot usually follows the injury. The maggots are also frequently common in turnips in autumn, particularly in the late sown crop. The eggs are laid among the heart leaves and the larvae mine through the crown into the bulbous root below. Much autumn turnip rot seems to follow root maggot attack. An additional form of injury follows maggot infestation of the plant heart. This is often very common in autumn cauliflowers and broccoli and results in blindness. The writer has also observed root fly maggots feeding in the stems of charlock and white mustard in September. In both cases the attacked shoots were killed.

To the root form of maggot injury brassicae appear to be most susceptible over a period ranging from the late seedling stage until some four to six weeks after setting out or singling. After this time, provided conditions for growth have been favourable, the plant is well established and generally possesses sufficient recuperative powers to overcome an attack. In addition, large, well-grown, woody plants appear to be considerably less attractive to the egg-laying females than the smaller, young plants. This is particularly so with flies of

the first brood, which emerge in late April and throughout May. These concentrate on the young crop and rarely lay on or near the overwintered plants. In consequence, brassicae transplanted in April and early May usually suffer much more heavily from root maggot attack than those set out later in the year.

Symptoms of Attack. The symptoms of root maggot attack are characteristic. Heavily infested plants make little growth, their leaves appear leaden to purplish in colour and the plants often remain permanently wilted until death occurs. An examination of their root system will reveal that most of the fibrous roots have been eaten away, whilst the main roots and stem base appear blackened. The maggots, dirty white in colour, are usually found embedded in this decaying tissue or in the neighbouring soil. Less severely attacked plants, their root systems only partially incapacitated, are prone to rapid wilting and can readily be distinguished from unattacked plants under conditions of high transpiration.

In certain districts of Bedfordshire where root maggot is common, crows appear to have learned to recognize attacked plants by the appearance of their tops. These they pull out, eating the grubs at the base. This habit is often carried out to an objectionable extreme when large numbers of very recently set out plants, which are temporarily in a wilted condition, are pulled up.

Life History. The Cabbage Root Fly overwinters in the soil as a puparium. According to Smith[1]* it passes through three generations during the year, the third of which is only partial since a certain proportion of the second generation puparia remain unhatched until the following spring. He also records that near Manchester flies from the overwintering generation commence to emerge about the end of the second week in May, the earliest record for that district being May 14. The writer, making observations over the last two years, has found that in the eastern counties the flies emerge at a considerably earlier date than this.

In 1937, a female was taken on May 4, and by May 12 adults of both sexes were present in numbers and eggs were also found. In 1938, although the date of emergence of the

* For references see p. 820.

first adults was not obtained, unhatched root fly eggs were found in the soil near cauliflower plants on April 27, and flies were taken on the same date. Since the time elapsing between hatching and egg laying appears to be about six days, the first adults must have emerged at least a week earlier than the above date. By May 2, flies and eggs were abundant and certain of the latter had hatched. In the third week in May, nearly fully fed maggots were found in the roots of cauliflowers, and many plants were showing advanced symptoms of root maggot attack. Maggots of a similar size were also found in Norfolk by Mr. D. Boyes on May 21 on March-transplanted cauliflowers.

These observations suggest that this apparently early emergence may be general on light soils in the eastern counties. They indicate also that on light soils in this area protective measures against root maggot on early-transplanted brassicae should commence at the beginning of the last week in April.

Methods of Control. The experimental work carried out in this country and abroad has all been directed towards preventing the root form of maggot attack, damage to the aerial parts of the plant not usually being sufficiently severe to warrant special control measures.

The more important of these control measures are as follows:—

(*a*) killing the adult flies by means of an attractive poison bait.
(*b*) prevention of oviposition by mechanical means,
(*c*) prevention of oviposition by deterrents,
(*d*) treatment of the plants with mercury salts.

Little success has been obtained with poison baits. No mixture has yet been evolved that is sufficiently lasting and attractive to the fly to be of practical value under English weather conditions.

The deposition of eggs in the soil near the plant can be prevented to a considerable extent by mechanical barriers placed about the stem base. Tarred felt discs placed round the plant stem, in immediate contact with the soil and applied directly after setting out, have given very favourable results. Unfortunately, the high costs of the discs themselves and the labour entailed in fixing and keeping free from soil rule out this method as being of no practical value except on very small holdings. A bitumen emulsion watered round the plant, so that on setting a hard crust is formed, is likewise said to give

considerable control. So far as is known this method has not been tried out in Great Britain.

Of the wide range of chemicals tested as deterrents, those which have given best results in this country are naphthalene and chlor-cresylic acid. In certain trials both have given good results, but in others very little benefit was obtained from their use. In common with most deterrents, both suffer an inherent disadvantage in that constant renewal is essential. The writer has found that flaked naphthalene broadcast at the rate of 200 lb. per acre may, under dry, warm conditions, completely disappear in five days. Naphthalene also may cause severe scorching when in contact with the foliage or root collar. These disadvantages are such that the control of root maggot by deterrents is liable to be an uncertain and expensive operation.

The most effective insecticides tested out so far for the control of root maggot are certain mercury salts. Until very recently, attention was focused almost entirely on corrosive sublimate (mercuric chloride). In many trials this chemical has given good results and in consequence has been widely recommended. The procedure for its application usually takes the form of watering the plant with a solution of strength 1 oz. of corrosive sublimate to 8 or 10 gal. of water. About ¼ pint of this solution is poured round the plant after setting out and twice subsequently at approximately weekly intervals. There are, however, serious objections to its use. It is intensely poisonous and must be handled with extreme care. It is toxic also to plant life and can be used only at low concentrations. Cauliflowers are particularly susceptible, and when treated with solutions stronger than 1 oz. to 10 gal. of water damage often results. With most other brassicae a concentration of 1 oz. to 8 gal. can be used with safety. Mercuric chloride damage to brassicae takes the form of stunting of the plant, an effect which becomes pronounced at concentrations greater than 1 oz. per 6 gal. of water (0.1 per cent.), and is then often accompanied by leaf and stem malformation. Such difficulties, coupled with those usually encountered in the application of liquids, render this method of control unsuitable for general use. A modification of it, however, is sometimes used commercially. It consists of drilling crystalline corrosive sublimate mixed with artificial fertilizer close to the plants after setting out. It is said to give some relief from maggot attack.

During the past decade it has been shown that calomel or

mercurous chloride is a potent soil insecticide for use against root maggots. It possesses, moreover, few of the disadvantages of corrosive sublimate, being non-poisonous to human and plant life. It is practically insoluble in water. Glasgow,[2] working in America, has shown that root maggot in brassica seedbeds can be considerably checked by applications of calomel to the seedlings after germination. The calomel may be applied in the form of a dust, mixed with an inert carrier or in suspension in water. Friend[3] has shown that root maggot in radishes can be controlled by similar means. In the control of onion maggot the writer has obtained excellent results with a 4 per cent. calomel dust distributed along the rows after germination. Since calomel is non-toxic to the plant, it is possible to use larger quantities than would be safe with corrosive sublimate and secure appreciably greater pest control without sacrifice of safety.

Control of Root Maggot in Cauliflowers with Calomel. In May, 1938, an experiment to test the value of calomel for the control of this pest on newly transplanted brassicae was set out at the Horticultural Research Station on land known to be heavily infected. An early variety of cauliflower was used and the plants were raised in cold frames. They were set out in the field on May 5 and watered in, the plants at this time being about 6 in. high and very sturdy.

There were nine rows, lettered consecutively A to I, each containing 108 plants 18 in. apart, the distance between the rows being 2 ft.

Table I shows the various treatments carried out, their times of application and the index letters of the rows under the different treatments.

TABLE I

Treatment	*Times of Application*	*Index Letters of Rows Treated*
Corrosive sublimate, 1 oz. per 10 gal. of water . . .	May 7, 17 and 27	C & H.
Calomel dust (4 per cent.)	May 7	E & I.
Calomel dust (4 per cent.)	May 7 and 20	B & F.
Control (untreated) . .	—	A, D & G.

Rows treated with corrosive sublimate were given ½ pint of solution per plant at each application. To assess the effect of this quantity of water on the incidence of root maggot, row D (control) was similarly treated with an equal quantity of rain

water. The root maggot infestation on this row was subsequently found not to be significantly different from that on the other two untreated rows, thus suggesting that the additional water had little effect on the extent of root maggot infestation in this experiment.

The 4 per cent. calomel dust was applied with a hand duster of the bellows type, each movement of the mechanism giving a single puff of dust. The nozzle of the duster was held very close to the base of the plant and the dust deposited in immediate contact with the stem where the latter enters the soil. At each application and for each row ⅝ lb. of dust was used, the rate per plant being approximately half a teaspoonful (2.8 grm.). This is equivalent to a rate of 30 lb. of dust per acre for plants spaced 1 yd. × 1 yd. It was found that the dust could not be applied properly with a hand duster of the blower type, a considerable wastage of material occurring.

Root fly eggs were present around the stems of these cauliflowers in mid-May and were about equally common on all treatments. By the second week of June several plants in the untreated rows were showing obvious symptoms of root maggot attack. Unfortunately, a high percentage of the plants had buttoned immediately after setting out, due almost certainly to the prevailing drought conditions. Such plants were equally common on all treatments. Since it was therefore impossible to harvest a crop it was decided to pull up the plants and examine the root systems for root fly larvae and their damage. This was done on June 21, the underground portions of each plant being carefully scraped for signs of damage. The results are given in Table II.

TABLE II

Treatment	*Plants Attacked (Percentage)*	*Total Cost of Material per Acre (4,840 plants)* s d
Corrosive sublimate (3 applications)	35·2	21 4
Calomel Dust (4 per cent) (1 application, 30 lb. per acre)	30·3	9 4
Calomel dust (4 per cent) (2 applications, each 30 lb per acre) .	5·6	18 8
Control (untreated) .	94 9	—

From the extent of the maggot damage to the root system it was possible with ease to pick out the calomel-treated rows without reference to the labels at the row ends. In those rows receiving two applications of calomel dust only some 5 per cent. of the plants were infected. On these, the damage

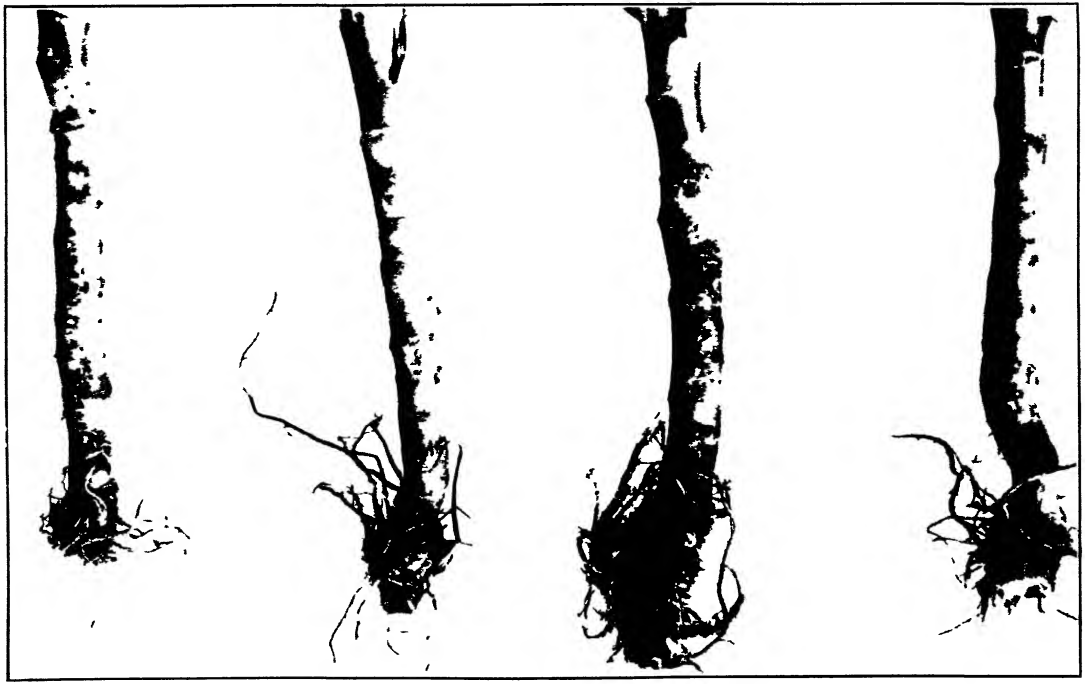

FIG. 1.—Stem and Root Systems of Cauliflowers receiving two applications of 4 per cent. calomel dust. Plants undamaged (× ½.)

To face p. 515.

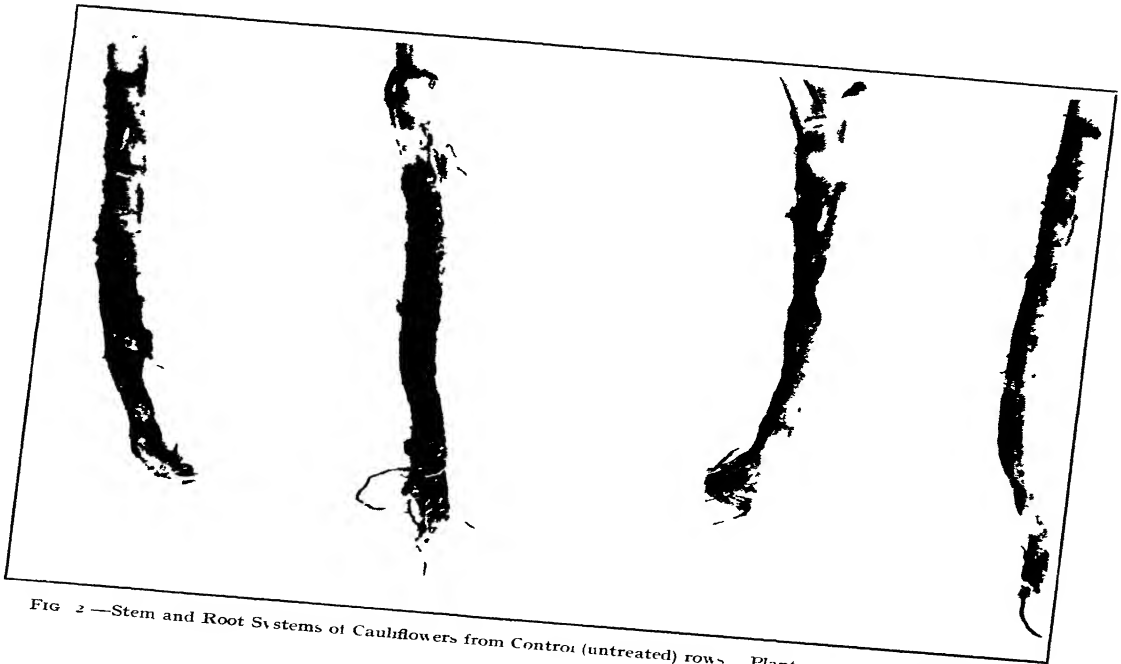

FIG. 2.—Stem and Root Systems of Cauliflowers from Control (untreated) rows. Plants severely damaged ($\times \frac{1}{2}$)

was slight and the maggots small (see Fig. 1). In those rows receiving only one application of dust, applied two days after setting out, no case of severe damage was found, although some 30 per cent. of the plants were infected.

The control given by three applications of corrosive sublimate was less complete than that obtained in either of the above treatments In these rows the root systems of certain of the plants had been completely destroyed and in many others the injury was severe.

In the untreated rows the plants were, on the average, considerably smaller than on either of the other treatments. The tops of many showed the characteristic symptoms associated with root maggot attack, while the root systems of more than 50 per cent. had been severely damaged. Plants almost devoid of lateral roots were common and fully grown maggots, feeding on the roots and stem base, were abundant in these rows at the time of the examination (see Fig. 2).

Cost of the Various Treatments. In the third column of Table II the cost of material per acre for plants spaced 1 yd. × 1 yd. (4,840 plants per acre) for the various treatments is set out. These are based on current prices at the time of the experiment, which were, 4 per cent. calomel dust 35*s*. per cwt., and corrosive sublimate 7*s*. 6*d*. per lb.

TABLE III.—TIME AND LABOUR PER ACRE (4,840 PLANTS TRANSPLANTED)

Treatment	*Time Taken per Application*	*Labour Costs per Application, @ 10d per hr*	*Total Labour Costs for All Applications*	*Total Cost o Materials and Labour for All Applications*
	hrs	*s d*	*s d*	*s d*
Calomel dust (4 per cent) (1 application)	3½	2 11	2 11	12 3
Calomel dust (4 per cent) (2 applications)	3½	2 11	5 10	24 6
Corrosive Sublimate (3 applications) ..	6½	5 5	16 3	37 7

In Table III the labour cost per acre for carrying out the different treatments has been calculated. These figures are based on the time taken in carrying out these operations in the above experiment. In the last column the total estimated cost of labour and materials for the different treatments is given.

Toxicity to the Plant. Calomel dust, applied as above, appears to be non-toxic to brassicae. It has been used by the writer at the rate of 35 lb. per acre on cauliflowers in the

following stages of growth; the cotyledonary stage, two days after setting out and on well-established plants transplanted some month previously. In no case was there any deleterious effect on the growth or vigour of the resulting plant. It is most probable that other brassicae would be similarly unharmed by it.

Conclusion. This experiment suggests that root maggot on brassica plants can be most effectively controlled by two applications of a 4 per cent. calomel dust. On early transplanted brassicae on light soils in the eastern counties the first application should be put on at the beginning of the last week of April followed by a second application some fourteen days later. On the heavier soils in this area these operations could, with little risk, be delayed an additional week. Brassicae transplanted later in the year should receive the first treatment within four days of setting out, preferably on the second or third days, by which time a crack will have developed between the stem and the surrounding soil. Every effort should be made to force the calomel dust into this crack, thus bringing it into the immediate neighbourhood of the root, where it is most effective.

Although in the above experiment a good control was obtained with 4 per cent. calomel dust applied at 30 lb. per acre per application, it is probable that under commercial conditions approximately 40 lb. of dust per acre for each application would be required to give a similar control. The cost of two applications, inclusive of labour, would then be about 30*s*. Where root maggot is liable to cause damage it is felt that the application of calomel dust as a routine measure would be a sound business proposition, particularly in view of the low cost of such a treatment.

ACKNOWLEDGMENTS The writer wishes to thank Mr D. Boyes, M.A., for valuable suggestions and criticisms, Mr. L C Comrie, B.Sc (Edin.), for assistance in examining the cauliflower roots, and Mr W E Dant who carried out the photography

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NOVEMBER ON THE FARM

R. W. Wheldon, D.Sc.,
King's College, Newcastle-upon-Tyne

The weather during early October was unfavourable for harvesting and much corn in the North suffered seriously in the stook. The lifting of the potato crop in some districts has been delayed owing to late harvest work and there is considerable anxiety on many farms lest frost occurs before the crop is safely gathered. Disease is reported in some areas, and frequent examination of the clamp is advised as a check on its rapid progress. Prices for most farm products are low and unless they improve the farmer is not likely to see much return for his labours in 1938.

Sheep. At this time of the year it is necessary to maintain the breeding stock in good condition to enable them to face the winter with a reserve that can be called on during periods of special stress.

With breeding ewes, special attention should be paid to the prevention of certain diseases. Treatment carried out now with respect of Liver Fluke will prevent trouble arising later. The treatment consists of administering capsules of carbon tetrachloride, which should be given under the direction and advice of the veterinary surgeon. A careful eye should also be kept on the future breeding stock, i.e., the ewe hoggs. On hill farms it is necessary to consider the risk of death from braxy. Braxy vaccine is an efficient preventive, and it is easily administered, but the treatment should be carried out under the advice of the veterinarian. Foot-rot is often troublesome in the autumn months, particularly on heavy land or where close folding is practised, and there is evidence that the disease is infectious. There is no doubt that running sheep through a foot-bath is an exceedingly simple and efficacious method of preventing the spread of the disease. Caustic remedies containing arsenic and copper sulphate are frequently used, but these are soon washed off in long, wet grass. It has been suggested that spent motor-car oil to which is added 4 per cent. of creosote may be used. This forms an antiseptic dressing that is not so easily washed off, and is worthy of a trial.

Sterility. Much can be done by the stockman to limit losses from sterility, which must be regarded not as a single disease, but as a manifestation of what may be a number of diseases It cannot be doubted that hereditary differences in fecundity exist in individual animals, but it is felt that these play a secondary part only and that the most important causes of animals remaining sterile for long periods lies in unfavourable conditions, which, to a large extent, can be rectified by intelligent management. Very briefly, sterility manifests itself as a result of errors in care and feeding, by the appearance of specific infections in the reproductive organs, or by the existence of sporadic diseases. For example, it is often associated with abortion. It is not possible here to go more fully into the above causes, but since these three causes taken together account for so much lowered fertility, with resultant reduction in productivity, it is highly desirable to adopt rational methods for control. The first signs of animals not breeding should be regarded seriously, and whenever there is the slightest indication that breeding troubles exist a stockowner should at once consult his veterinary adviser. Where action is taken early the losses in many herds may be greatly reduced. The stockman should keep a careful record of services, breaks, etc., to enable him to detect any lapses in breeding efficiency at an early stage. Active measures of a preventive nature are called for. Feeding and management are important.

Milk. Enquiries are frequently received from milk producers with reference to milk falling below the prescribed standard in butter-fat and solids-not-fat.

The Sale of Milk Regulations, 1901, provide that a sample of milk that contains less than 3 per cent. of butter-fat, or less than 8.5 per cent. of solids-not-fat, is to be presumed for the purposes of the Food and Drugs (Adulteration) Act, 1928, not to be genuine until the contrary is proved.

In the large majority of instances mixed milk from farms complies with the above standard, but it does sometimes happen that for reasons quite outside the control of the producer the bulk milk falls below this standard. Investigations indicate that the factors responsible for variation in the quality of milk are numerous, and that the one responsible for the greatest variation in the fat content is probably inequality of milking intervals. Collins (Armstrong College) found, after

examining samples from a variety of sources, that when the intervals between milking are about 12 hours (e.g., cows milked at 6 A.M. and 6 P.M.), the morning fat exceeds evening fat by 0.18 per cent. on the average of 22 tests. When the intervals are about 13 and 11 hours, (e.g., cows milked at 6 A.M. and 5 P.M.), the evening fat exceeds the morning fat by 0.33 per cent. on the average of 192 tests. When the intervals are about 14 and 10 hours, (e.g., cows milked at 6 A.M. and 4 P.M.), the evening fat exceeds morning fat by 0.70 per cent. on the average of 18 tests. When the intervals between milking are about 14½ and 9½ hours, (e.g., cows milked at 6 A.M. and 3.30 P.M.), the evening fat exceeds morning fat by 1.09 per cent. on the average of 391 tests. It is desirable, therefore, that, whenever circumstances will permit, the milking intervals should be as near 12 hours as possible when cows are milked twice daily, and as near 8 hours as possible with animals milked three times daily. Collins did not find that unequal milking periods influenced the solids-not-fat in the same way as the fat content.

The period of lactation also affects the quality of the milk. Under good management the yield of cows generally increases from calving up to about six weeks. There is some indication that as the milk output increases the quality of the milk may be slightly reduced, so that when a cow is giving its maximum yield the milk may be relatively poor both as regards fat and solids-not-fat. Experience shows that when a large number of cows have calved at the same time the quality of the bulk milk may be influenced by this factor. This is especially so when there are a number of high-yielding cows involved.

Another important factor is efficiency in milking. As the strippings are relatively rich in butter-fat, it is important that each cow in the herd should be efficiently stripped. When instances of low butter-fat content occur inquiry should be made into the efficiency of the milking, whether hand or machine.

Poor quality has sometimes been traced to wrong feeding, but occasionally milk deficient in solids has persisted even where sound feeding has been practised. It has often been stated that feeding has little influence on the quality of the milk, although it must be admitted that there is considerable evidence to suggest that certain foods might have a temporary effect in raising the butter-fat content. When cows are well fed prior to calving, and steps taken to ensure that they are

in really good condition, there is a beneficial effect on the quality of the milk.

While it is desirable that the rations fed to a dairy herd should contain an adequate supply of minerals, owing to the fact that nearly 1 lb. of mineral matter is found in 15 gal. of milk, harm may accrue if excessive quantities of minerals are fed. There is a suggestion that the excessive feeding of certain minerals may have a harmful effect on the secretion of the solids in milk. The National Institute for Research in Dairying has suggested that low non-fatty solids may be associated with the taking of excessive quantities of water by the animal. While the constituent deficient in the milk is frequently sugar, it was found that at the same time there was an increase in the chlorine content. It is suggested that it is not so much the taking of excessive water as the saline content which may be harmful. When animals are fed on pasture and crops grown on land that has been well and efficiently manured the need for additional minerals is not so great. Good farming, involving the right use of fertilizers, is a great help not only in producing increased crops, but also crops that have a higher feeding value.

Sudden changes in temperature may increase or decrease the butter-fat. Age is also a factor, as it is found that as cows grow older the quality of milk produced tends to fall. Moderate exercise is advisable as, apart from the fact that it helps to maintain the cows in health, it seems to have a slight effect in increasing the butter-fat. The importance of careful mixing of the milk from a considerable number of cows cannot be over-estimated.

Breeding and individuality are other factors. As a rule, milk from Channel Island breeds, such as the Jersey and Guernsey, seldom falls below the legal presumptive standard, as for generations these breeds have been bred for high butter-fat and solids. With Ayrshires, Shorthorns and Friesians, there may be occasions when the standard of the milk falls rather low. Breeders are now paying attention to this important factor of quality in milk and there is much evidence to show that good results may be obtained and the average quality of the milk can be considerably improved by breeding within the breed from individual animals that are characterized by yielding milk of high quality.

MISCELLANEA

Livestock Improvement, 1937-38

The Ministry's activities, statutory and administrative, in regard to the improvement of live stock for the year ended March 31, 1938, are here briefly reported. Included in this survey is an account of the exercise of powers contained in the Horse Breeding Act, 1918, as regards the licensing of stallions, and in the Improvement of Live Stock (Licensing of Bulls) Act, 1931.

Apart from these statutory functions, the Ministry administers a Scheme for the Improvement of Live Stock, the main object of which is to direct the attention of farmers, especially the smaller farmers, to the value of using pedigree sires for grading up their farm stock, and of keeping records of the milk yield of their cows with the object of getting rid of poor milkers, obtaining information for economic rationing, and generally improving, by judicious selection, the productiveness of their herds. Under the Scheme, grants are awarded by the Ministry to enable farmers to obtain, at reasonable service fees, the use of pedigree bulls and boars that have been approved by the Ministry's Live Stock Officers; a few grants for the improvement of Welsh Mountain Sheep are also provided. As regards heavy horses, grants or premiums —direct and by way of assisted nominations—are made to Societies in connexion with the hiring of stallions. In addition, grants are made to Societies whose members record the milk yield of their cows.

General. An important change was effected in the Live Stock Improvement Scheme during the year whereby more grants for premium bulls were made available, and at the same time the basis of payment of grants was revised in order to give greater assistance to custodians at the time when the purchase of a new bull became necessary. This alteration is referred to in greater detail later in this report.

There are definite indications that the cattle industry has benefited by the subsidy payable under the Livestock Industry Act, 1937, which has encouraged the rearing of a better class of stock.

The pig industry has shown little change during the year. The high prices of feeding stuffs have tended to make the

smaller farmer give up pig-keeping, but despite this the number of premium boars in location has been maintained, while there was actually an increase in the number of owners sending sows for service.

The number of stallions travelled by Heavy Horse Societies in receipt of grants from the Ministry showed a further increase on the year, and there is no doubt as to the special value of the work being performed under this section of the Scheme.

Licensing of Bulls. It will be seen from Table I below that the number of bulls dealt with showed very little change from the previous year and it may be assumed that a state of normality has now been reached as far as original applications for licences are concerned. It is satisfactory to note that although it is the policy of the Ministry to raise gradually the standard that bulls must attain to be licensed, the number of bulls rejected amounted to only 13.9 per cent. of the number examined, as against 14.9 in 1936-37. There can be little doubt that as a result of the operation of the Act there has been a marked improvement in the type of bull kept for breeding, and it is evident that more care is now being taken in the selection of calves for rearing as bulls.

TABLE I.—PARTICULARS OF APPLICATIONS FOR BULL LICENCES

	Twelve Months ended March 31, 1937	*Twelve Months ended March* 31, 1938
Applications for Licences received	43,722	43,190
Licences issued .	37,848	36,685
Rejections notified	6,663	5,942
Permits issued	72	65
Licences suspended	31 (*a*)	32 (*a*)
Licences transferred	33,673	41,188
Appeals to referees received	567	645
Appeals to referees dealt with	540 (*b*)	657 (*c*)

(*a*) Licences suspended pending recovering of the bulls from temporary forms of disease (mainly ringworm).

(*b*) Of these 299 were decided in favour of the appellant, while in 241 cases the Ministry's decision was confirmed.

(*c*) Of these 346 were decided in favour of the appellant, while in 311 cases the Ministry's decision was confirmed.

The 65 permits issued were all in respect of " rig " bulls which the owners desired to keep for a limited period for fattening purposes. There was a further large increase of 7,515 in the number of licences transferred on change of ownership, and the number of transferred licences now exceeds the number of new licences issued.

TABLE II.—PARTICULARS BY BREEDS OF BULLS LICENSED AND REJECTED

	Twelve Months ended March 31, 1937		Twelve Months ended March 31, 1938	
	Licensed	Rejected	Licensed	Rejected
Aberdeen Angus .	760	61	755	66
Ayrshire	445	67	489	52
Blue Albion	48	10	46	11
British Friesian	2,502	314	2,671	320
Devon	1,031	134	1,091	101
Dexter	35	1	33	—
Dun and Belted Galloway . .	10	—	3	—
Galloway .	289	34	248	22
Gloucestershire	7	3	2	—
Guernsey	1,882	111	1,924	192
Hereford	2,194	404	2,116	322
Highland	4	—	7	1
Jersey	613	27	545	26
Kerry	19	1	19	2
Lincoln Red Shorthorn	1,604	204	1,324	200
Longhorn	8	—	5	—
Park . .	10	2	19	5
Red Poll	623	117	569	99
Shorthorn	24,600	3,990	23,730	3,725
South Devon	423	33	439	29
Sussex . .	189	14	235	19
Welsh Black	393	68	349	66
Crossbred	159	1,068	66	684
TOTAL	37,848	6,663	36,685	5,942

Table II indicates that there has not been any significant change proportionately in the number of bulls of the various breeds submitted for licence, but the number of crossbred bulls showed a considerable decline and over 91 per cent. of these were rejected as unsuitable for breeding.

It should be explained that the bulls included under any particular breed in this Table are not necessarily pedigree or pure bred, but include all bulls in which the characteristics of that particular breed are predominant.

Although instances of deliberate evasion of the requirements of the Act are, comparatively speaking, of rare occurrence, the Ministry's Live Stock Officers do still find a certain number of unlicensed bulls, and proceedings were instituted against bull owners in 98 instances for keeping bulls without licences after they had reached the age of 10 months.

Two of these cases arose through the owners refusing to apply for transfer of a licence on change of ownership. There were 10 prosecutions for failure to comply with the order requiring castration or slaughter of rejected bulls or for the movement of rejected bulls otherwise than to a slaughter-house for the purpose of slaughter. Fines ranging from 2*s*. 6*d*. to £25 were imposed in 92 cases, and 13 were dismissed on payment of costs.

Licensing of Stallions. The number of stallions licensed under the Horse Breeding Act, 1918, has increased steadily since 1930, and in the year under review the number of licences issued was 2,156, an increase of 48 (2.3 per cent.) on the previous year and 726 (50.8 per cent.) over the 1930 figure.

TABLE III.—LICENSING OF STALLIONS

Year (ending October 31)	*No. of Applications for Licences*	*No of Licences Issued*	*No of Refusals*
1920	4,153	3,749	404
1921	4,060	3,816	244
1922	3,644	3,479	165
1923	2,897	2,761	136
1924	2,285	2,210	75
1925	1,908	1,849	59
1926	1,664	1,608	56
1927	1,574	1,537	37
1928	1,454	1,414	40
1929	1,472	1,436	36
1930	1,472	1,430	42
1931	1,470	1,432	38
1932	1,522	1,477	45
1933	1,556	1,516	40
1934	1,732	1,687	45
1935	1,945	1,893	52
1936	2,124	2,050	74
1937	2,172	2,108	64
1938	2,229	2,156	73

The greatest increase is in light horses, including ponies and cobs, the number licensed having risen from 252 in 1937 to 288, probably a result of the greater interest taken in riding. Heavy horses increased by 12 only. Clydesdales increased by 20 and Suffolks by 18, whilst Shires, in respect of which 1,210 licences were issued, decreased by 23. Percherons also show a slight decrease (3).

TABLE IV.—NUMBERS OF LICENCES GRANTED UNDER THE HORSE BREEDING ACT, 1918, IN ENGLAND AND WALES, 1937 AND 1938

BREED OR TYPE	Pedigree (i.e., Stallions entered or accepted for entry in the recognized Stud Book of their Breed)		Non-Pedigree (i.e., Stallions not entered or accepted for entry in a recognized Stud Book)		Totals of each Breed and Type (Pedigree and Non-Pedigree)	
	1937	1938	1937	1938	1937	1938
HEAVY						
Shire	1,075	1,050	158	160	1,233	1,210
Clydesdale	174	194	30	30	204	224
Suffolk	240	260	4	2	244	262
Percheron	105	102	6	6	111	108
Others	—	—	64	64	64	64
Total Heavy Horses	1,594	1,606	262	262	1,856	1,868
LIGHT						
Hackney	6	7	5	6	11	13
Thoroughbred	147	159	3	2	150	161
Arab	10	15	1	2	11	17
Others	3	4	3	11	6	15
Total Light Horses	166	185	12	21	178	206
PONIES AND COBS						
Welsh	4	3	3	1	7	4
Fell	6	5	1	1	7	6
Dales	8	12	2	5	10	17
Polo and Riding	9	9	3	2	12	11
Welsh Cob	18	16	18	23	36	39
Others	2	5	—	—	2	5
Total Ponies and Cobs	47	50	27	32	74	82
TOTALS	1,807	1,841	301	315	2,108	2,156

The number of stallions refused licences was 73—an increase of 9 over the 1937 figure. Refusals on account of defective physique and conformation rose by 6 on the previous year. 22 appeals against refusals were lodged, 13 being successful, as against 11 appeals, of which 4 were successful in the 1937 season. One licence granted for the 1938 season was revoked.

47 infringements of the Act were reported to the Ministry, a decrease of 12 on the previous season. In one case the

police took proceedings in respect of the travelling of an unlicensed stallion, the owner being fined 5*s.* and £1 1*s.* 0*d.* costs. The majority of the other infringements were in respect of the travelling or exhibiting for service of licensed stallions unaccompanied by their licences, and the owners and leaders were warned as to the requirements of the Act.

Premium Bulls. The revised rates of subsidy payable under the Livestock Industry Act, 1937, and particularly the higher rate for " quality " cattle, have undoubtedly led to an improvement in the trade for both fat stock and store stock. The recent tendency in some districts to concentrate on milk production and milk production alone led to indiscriminate breeding, with the result that in many districts the cattle, particularly after the first cross, were reported to be lacking both in quality and breed characteristics. Fortunately, there are signs of the production of a better type of stock. Prudent farmers are now paying more attention to the dual purpose qualities of their cattle, and bulls with more bone and constitution are in greater demand for the production of calves fit to be kept for rearing.

In connexion with the Government's programme for the improvement of grass land and the production of quality beef, the Ministry extended the premium bull scheme by placing out an additional number of premium bulls of the beef and dual purpose types with suitable custodians, and the annual financial provision for the premium bull section of the Scheme was augmented.

With the increase in the number of grants, opportunity was taken to review the Scheme in the light of recent experience. It has been pointed out in previous reports that one of the factors adversely affecting the distribution of premium bulls was the initial purchase outlay involved, and as this factor has also, on occasions, militated against bulls of really good quality being bought, it was decided that, instead of grants being made as hitherto on the basis of one-quarter of the purchase price or estimated value each year (subject to a maximum of £20), a grant of one-half the purchase price or estimated value (subject to a maximum of £40) should be paid on the location of a new bull. This initial grant covers a period of two years, and, if the bull remains in location for two complete years, a further grant in respect of the initial two-year period of one-twelfth of the purchase price or estimated

value (maximum £7) may be paid. For bulls which remain in location for more than two years, additional grants will be made for each further year on the basis of one-quarter of the purchase price or estimated value (maximum £20).

It will be seen from Table V that, as a result of the increased financial provision already referred to, the record number of 1,547 bulls were subsidized in the year.

TABLE V.—NUMBER OF BULLS SUBSIDIZED EACH YEAR SINCE THE COMMENCEMENT OF THE SCHEME

Year (*April* 1—*March* 31)	*No. of Bulls*	*Year* (*April* 1—*March* 31)	*No. of Bulls*
1914–15	497	1926–27	1,287
1915–16	633	1927–28	1,372
1916–17	659	1928–29	1,408
1917–18	710	1929–30	1,476
1918–19	721	1930–31	1,537
1919–20	675	1931–32	1,494
1920–21	668	1932–33	1,452
1921–22	847	1933–34	1,469
1922–23	947	1934–35	1,476
1923–24	978	1935–36	1,469
1924–25	1,069	1936–37	1,447
1925–26	1,175	1937–38	1,547

It is economically impossible for each small farmer to purchase a high-class bull and it is to the small farmer that the Scheme is of the greatest benefit. During the year an average of 16 members sent 69 cows for service to each premium bull, an increase in the average number of services of one over the previous year.

Premium bulls that have completed their term of service continue to be sold for use in private herds, and in some districts the competition for these bulls is very keen. In Wales, several have been sold for £60 or over to continue as sires in private herds, and in Devonshire one was sold for 100 gns. and another for 70 gns. A bull, purchased at Exeter Sale for 64 gns., served three years under the Scheme, and was then sold to another custodian for £40. After serving a further period of three years with the new Society, the bull was sold to a breeder for 58 gns. During the year, the first Society comprised wholly of members with Attested Herds was formed in Wales.

Numerous successes of premium bulls and their progeny at shows and sales continue to be reported. The Hereford bull "Sultan," exhibited by H.M. The King at the Royal Welsh Show, which secured first in its class and the reserve cham-

pionship for Hereford bulls, was bred in Breconshire by a premium bull owner.

Breeds and Prices. It has already been pointed out that one of the reasons for amending the Regulations was to improve the standard of the bulls purchased for the Scheme. The average price of the bulls purchased during the early part of the year, before the new Regulations came into force, was just under £43 10*s*. 0*d*. (which is about £1 8*s*. 0*d*. higher than the average price for the previous year). The average price in the latter part of the year, under the new Regulations, was approximately £59, making an over-all average for the year of £49 9*s*. 2*d*.

TABLE VI.—NUMBER AND AVERAGE PRICES OF PREMIUM BULLS

BREED	1935–36 No.	1935–36 Average Price £ s. d.	1936–37 No.	1936–37 Average Price £ s. d.	1937–38 No.	1937–38 Average Price £ s. d.
Aberdeen Angus	5	39 5 5	4	39 18 0	7	56 2 0
British Friesian	6	49 6 0	8	51 4 6	5	51 6 0
Devon	202	46 7 3	205	48 7 5	234	60 0 9
Galloway	3	27 6 0	3	24 16 4	2	38 0 0
Guernsey	29	39 2 10	25	42 13 2	19	41 1 3
Hereford	218	39 15 5	229	42 10 3	269	54 2 1
Lincolnshire Red Shorthorn	157	39 4 7	153	41 0 3	163	44 6 5
Red Poll	1	31 10 0	1	52 10 0	6	46 16 8
Shorthorn	750	40 12 2	718	42 1 0	731	47 17 4
South Devon	14	40 4 5	16	42 8 6	19	47 7 0
Sussex	7	31 14 5	6	31 19 0	5	39 0 10
Welsh Black	77	27 2 11	79	27 1 5	87	32 7 5
ALL BREEDS	1,469	40 6 11	1,447	42 1 7	1,547	49 9 2

Over 57 per cent. of the total number of bulls subsidized are Shorthorns (including Lincolnshire Red Shorthorns). Of the 1,547 bulls in location during the year, 1,119 may be described as being of beef or dual-purpose type.

Service Fees. Despite the higher standard of the bulls provided, the service fees still show a tendency to fall, the proportion of fees of 5*s*. and under having increased from 84.7 to 86.4 per cent. The most popular fee is 5*s*.

Premium Boars. The collapse of the Pig Marketing Scheme led to a reduction of the breeding sows kept, and the high prices of feeding stuffs have also had their effect on pig-

keeping, with the result that market prices during the year have been higher owing to the smaller supplies that have been available.

The tendency for the "small man" to give up pig-keeping has continued, and it would appear that the trade is getting more into the hands of the large farmers. Despite this movement, however, there was an increase in the number of owners sending sows to premium boars kept under the Ministry's Scheme in the year under review. The improvement in the standard of pigs kept, to which reference was made in last year's report, seems to have been maintained.

TABLE VII—NUMBER OF BOARS SUBSIDIZED EACH YEAR SINCE THE COMMENCEMENT OF THE SCHEME

Year (*April* 1—*March* 31)	*No. of Boars*	*Year* (*April* 1—*March* 31)	*No. of Boars*
1914–15	115	1926–27	844
1915–16	193	1927–28	907
1916–17	216	1928–29	933
1917–18	264	1929–30	972
1918–19	350	1930–31	1,047
1919–20	399	1931–32	1,024
1920–21	441	1932–33	973
1921–22	550	1933–34	1,007
1922–23	569	1934–35	1,032
1923–24	638	1935–36	1,029
1924–25	655	1936–37	1,013
1925–26	710	1937–38	1,014

Table VII shows the number of boars subsidized each year since the commencement of the Scheme, and in all the circumstances the fact that the number of boars has been maintained at the level of the previous year can be considered as satisfactory.

The number of owners sending sows to premium boars increased from 22,295 in 1936-37 to 22,495, but the number of services during the year decreased from 60,013 to 57,218, and the average number of services per boar from 60 to 57.

Breeds and Prices. The particulars given in Table VIII show that there were only 39 subsidized boars of breeds other than Large White in the whole country and of these 27 (all Welsh boars) were in Wales. Of the 108 new grants awarded during the year, 105 were in respect of Large Whites and 3 in respect of Welsh boars.

The average prices of the boars purchased for location under the Scheme generally showed an increase during the year, Large Whites advancing from £10 18*s*. 0*d*. in 1936-37 to £11 2*s*. 10*d*., and the average price of all breeds from £10 18*s*. 4*d*. to £11 3*s*. 2*d*.

Service Fee. The service fees still show a tendency to decrease and 91 per cent. are now 5*s*. or under.

TABLE VIII.—NUMBER AND AVERAGE PRICES OF BOARS OF EACH BREED

BREED	1935–36		1936–37		1937–38	
	No.	Average Price	No.	Average Price	No.	Average Price
		£ s. d.		£ s. d.		£ s. d.
Berkshire ..	1	15 15 0	1	15 15 0	—	—
Cumberland	2	7 7 3	1	11 0 0	1	11 0 0
Essex .	1	8 0 0	1	8 0 0	—	—
Large Black	3	10 6 8	3	10 6 8	2	12 7 11
Large White .	970	10 18 0	964	10 18 0	975	11 2 10
National Long White Lop-eared	10	10 13 7	8	11 1 2	3	12 5 0
Middle White	8	10 7 8	6	9 14 4	3	9 16 0
Wessex Saddleback	1	13 13 0	2	8 18 6	3	9 19 6
Welsh	33	11 8 10	27	11 18 5	27	11 16 7
ALL BREEDS	1,029	10 18 2	1,013	10 18 4	1,014	11 3 2

Premium Rams. Thirty grants for Welsh Mountain rams were again awarded for the 1937 season. Hiring fees ranged from £7 10*s*. 0*d*. to £18—the latter being a record fee for the Scheme—and service fees from 1*s*. to 3*s*. 6*d*. Twenty-six of the rams were hired at £10 or over. During the 1937 season, 224 owners sent 1,811 ewes for service, an average of 60 per ram. The champion ram at the Royal Welsh Show was sired by a premium ram.

Horse Breeding: Heavy Horse Grants. The good trade in heavy horses experienced in the past two years has been fairly well maintained and conditions in this branch of farming are much more satisfactory than they were a few years ago. This is reflected in a further increase—from 193 in 1936 to 200 in 1937—in the number of stallions travelled by Societies under the Ministry's Heavy Horse Breeding Scheme. The Scheme has done much to encourage the industry and to assist farmers, especially the smaller farmers, to secure the use of a good sire for the service of their mares.

The excellence of the horses travelled by Societies under the Scheme has had the effect of raising the standard of privately owned stallions which travel in competition with them, and the general standard of these horses is reported to be fairly satisfactory.

Reference has been made in the last two reports to the show record of the progeny of one of the stallions subsidized under the Scheme. At the 1938 Shire Horse Show the progeny of this stallion secured the Supreme Championship, and also the Junior Championship. This sire has been hired by Societies subsidized under the Ministry's Scheme in every year but one since 1930.

There were 154 Shire, 24 Clydesdale and 22 Suffolk stallions subsidized under the Scheme in 1937 compared with 150 Shire, 22 Clydesdale and 21 Suffolk stallions in 1936. With the exception of three in Hampshire, the Clydesdales travel in Northumberland, Durham and the North Riding of Yorkshire. All the Suffolks are hired by Societies in Norfolk, Suffolk and Essex. The average hiring fee was £228—£1 less than in the previous year—and the average service fee of £2 10s. 4*d*. compares with £2 10s. 10*d*. in 1936.

The popularity of the Scheme among the small farmers in the country is shown by the fact that 5,668 small holders each had a mare served, an increase of 380 over the previous year. The total number of mares served increased from 18,988 to 19,323.

The number of foals resulting from the services of subsidized stallions in 1936 was 10,845, and the percentage of foals to the number of services was 59.3. The comparable figures for 1935 were 9,734 and 57.4. The average foaling percentages of the stallions of the three breeds were Shire 60.0, Clydesdale 51.6 and Suffolks 66.0.

(*To be concluded*)

Sampling Observations on Wheat, 1937-38: Report for Fourth Quarter

The observations are summarized in Table I, which gives for each of the nine stations the density and height of the crop at the last observation before harvest, the date of harvest and the yields of grain and straw at harvest. The mean yields of the two standard varieties over all stations (excluding Boghall) are shown below for each of the past six years:—

Mean Yield of Grain (Cwt. per Acre)

1933	1934	1935	1936	1937	1938
24·1	34·1	30·4	24·7	20·0	

The figures indicate that the present season is substantially

TABLE I.—SAMPLING OBSERVATIONS ON WHEAT, 1937–8: FOURTH QUARTER.

Station	Variety	Last Observations			Date fit for cutting	Date of Harvest		Yields, cwt. per acre			
								Grain		Straw	
		Date	Ear Density per 32m.	Ear Height c m.		1937–8	Average 1933–7	1937–8	Average 1933–7	1937–8	Average 1933–7
WYE,	S.H.M.*	July 29	1,733[1]	127·8	Aug. 3	Aug. 3	Aug. 6[2]	35·9	20·3	66·4	49·6
Kent .. .	Yeoman	July 29	2,057[1]	114·9	Aug 3	Aug. 3	Aug. 6[2]	35·7	25·9	65·3	46·3
PLUMPTON,	S H.M.	Aug. 5	1,652	102·0	Aug. 7	Aug. 10	Aug. 6[2]	24·2	32·5[2]	47·6	38·6
Sussex . ..	Yeoman	Aug 5	1,726	88·1	Aug. 7	Aug. 10	Aug 6[2]	20·5	32·4[2]	37·7	40·2
CIRENCESTER,	S H.M.	July 21	1,346	99·1	Ang. 11	Aug 11	Aug. 8[2]	19·2	28·0[3]	32·3	48·9[3]
Gloucestershire ..	Yeoman	July 21	1,565	85·2	Aug. 11	Aug 11	Aug 8[2]	17·3	29·8[3]	32·0	48·1[3]
	Little Joss	July 21	1,176	102·7	Aug. 11	Aug 11	—	18·9	—	30·2	—
NEWPORT,	S.H.M	Aug. 16	1,275	52·0	Aug. 13	Aug 16	Aug. 15	38·0	32·0	57·0	65·2
Shropshire ..	Yeoman	Aug 16	1,290	41·2	Aug. 15	Aug. 17	Aug. 15	31·4	33·5	52·0	60·6
BOGHALL,	S.H.M.	Sept. 8	1,444	100·9	Aug 31	Sept 9	Aug. 31[2]	24.6	31·3	56.1	58·1
Edinburgh ..	Yeoman	Sept. 8	1,572	93·3	Sept 2	Sept. 9	Sept. 2[2]	25.5	32·6	62.5	62·1
WOBURN,	S H M	July 29	1,815	89·5	Aug. 3	Aug. 3	Aug. 1	20·0	22·1	37·8	51·9
Bedfordshire .	Yeoman	July 29	1,967	78·2	Aug. 3	Aug. 3	Aug. 1	17·7	24·8	32·6	47·2
NEWTON ABBOT,	S H M	July 14	2,023	132·0	Aug. 5	Aug 6	July 31	36·7	26·2	61·9	45·2
(Sealé-Hayne Coll.)	Yeoman	July 14	2,149	114·9	Aug. 6	Aug. 6	Aug 1	36·7	23·5	63·8	39·4
Devonshire ..	Victor	July 14	1,925	125·9	Aug. 5	Aug. 6	—	35·4	—	65·4	—
ROTHAMSTED,	S.H.M.	Aug. 2	1,542	98·0	Aug. 5	Aug. 6	Aug. 6	30·6	25·2	46·8	47·9
Hertfordshire ..	Yeoman	Aug. 2	1,606	84·4	Aug. 6	Aug. 6	Aug. 6	28·2	27·1	44·7	48·5
	Victor	Aug 2	1,319	90·1	Aug. 6	Aug. 6	—	31·8	—	43·4	—
SPROWSTON,	S.H.M.	Aug 6	1,390	111·5	Aug. 6	Aug. 10	Aug. 12	22·0	24·7	35·6	35·3
Norfolk	Yeoman	Aug. 6	1,569	101·9	Aug. 8	Aug. 10	Aug. 12	22·9	22·0	40·3	33·6

* = Squarehead's Master. [1] = on July 17. [2] = Omitting 1933. [3] = Omitting 1933 and 1935.

better than last season for wheat and probably also better than 1936. Yields have not, however, attained the high levels of 1934 and 1935. While it must be remembered that these averages are based on eight stations only, the results do not support the claims which have been made for the present season as a record wheat year in certain sections of the daily Press. It is, however, reassuring to find that yields are well up to the average after a drought of exceptional duration in early spring.

The crops appear to have ripened rather slowly, presumably owing to the deficiency of sunshine in July, for though the ears were early in emerging, the harvest samples were not cut until a few days later than usual at most stations. Squarehead's Master gave higher yields of grain than Yeoman at six stations out of eight, while the yields were identical at Newton Abbot. In past years there has usually been little to choose, on the average, between the two varieties. The additional varieties grown at Cirencester, Newton Abbot and Rothamsted gave about the same yields as the standard varieties.

From the results of the first five years' observations, a formula was developed to predict the mean yields of grain of the two standard varieties from measurements of the plant density at tillering, the shoot height at ear emergence and the number of ears. The predictions for this year are compared with the observed yields in Table II, which also contains for comparison the averages of previous years at each station.

TABLE II

OBSERVED AND PREDICTED YIELDS · GRAIN (CWT. PER ACRE)

Station	Average 1933–7		1938	
	Obs.	Pred.	Obs.	Pred.
Newton Abbot (Seale-Hayne Coll)	25	27	37	37
Rothamsted . .	26	27	29	25
Newport	38*	37*	35	32
Boghall . .	32	30	25	23
Sprowston .	23	27	22	32
Plumpton . .	33*	32*	22	25
Wye .	26*	30*	36	29
Woburn .	—	—	19	23
Cirencester	—	—	18	17
Mean .	—	—	27	27

* Based on 4 years only.

With the exception of Sprowston and Wye, the formula has been successful this year in distinguishing between the high-yielding stations and the low-yielding stations. The averages of the observed and predicted yields over the nine stations are incidentally 27.0 cwt. For a study of the possibility of predicting wheat yields in advance of harvest, these experiments become more valuable every year, particularly in view of the satisfactory completeness of the observations in recent years.

Dry matter observations were taken as usual at Newport and Rothamsted.

Errata. Owing to an error in one of the observation books, the observations on tillering given in the second quarter's report (see this JOURNAL, June, 1938, p. 295) for Yeoman at Newport should read :—

Date :	Mar. 4·83 instead of Mar. 4·24.
Rate	22·7 instead of 23·1
Plant number .	390·0 ,, 382·2.

The plant number for the first count of Squarehead's Master at Wye should read 1660 instead of 1677.

Marketing Notes

Milk Marketing Scheme *Prices for September* The wholesale price for liquid milk (other than Tuberculin Tested milk) in September, 1938, was 1*s*. 3*d*. per gal, the same as in the previous month and in September, 1937, the wholesale price for Tuberculin Tested milk in September, 1938, was 1*s*. 5*d*. per gal.

Pool prices for September, 1938, are given below, with comparative figures for August, 1938, and September, 1937.

	Pool Prices		
	Sept, 1938	*Aug.*, 1938	*Sept*, 1937
	d	*d*	*d*
Northern	11¾	11½	12¼
North-Western ..	11¾	11½	12½
Eastern .. .	12	11¾	12¾
East Midland . . .	12	11½	12½
West Midland	11¾	11¼	12
North Wales .	11¾	11¼	12
South Wales . .	11¾	11½	12½
Southern	12¼	12	12¾
Mid-Western .	11½	11¼	12
Far-Western . .	11½	11	12
South-Eastern .	12¼	12	13
Unweighted Average .	11·84	11·50	12·39

These prices are exclusive of any premium for special services and level deliveries, and also of the quality bonuses for Accredited and Tuberculin Tested milks. The estimated gallonage on which quality premiums have been earned was 35,944,603

The inter-regional compensation levy was fixed at 1¼d. per gal., compared with 1*d*. per gal. in September, 1937. Sales on wholesale contracts were as follows —

	Sept., 1938 (*estimated*) *Gal.*	*Sept.*, 1937 (*estimated*) *Gal.*
Liquid	50,640,284	49,261,035
Manufacturing	24,163,893	18,161,408
	74,804,177	67,422,443
Percentage liquid sales	67·69	73·06
Percentage manufacturing sales	32·31	26·94

The average realization price of manufacturing milk during September was 6·95*d* per gal, compared with 6·42*d*. per gal. for September, 1937. The quantity of milk manufactured into cheese on farms was 2,810,919 gal., compared with 3,295,852 gal in the previous month and 2,302,175 gal. in September, 1937.

Premiums on Quality Milks The Milk Marketing Board have now informed the Minister of Agriculture and Fisheries that, as from October 1, 1938, they propose to pay increased premiums and allow increased rebates for quality milks on scales approved by Ministers and corresponding to those foreshadowed in the White Paper on Milk Policy (Cmd 5533).

Committee of Investigation The Tuberculin Tested Milk Producers' Association have made a formal complaint to the Minister under Section 9 of the Agricultural Marketing Act, 1931, as to the operation of the Milk Marketing Scheme in connexion with the levy payable by producer-retailers of Tuberculin Tested milk, and as to the inability of the Board to make payment from October 1, 1938, of increased quality premiums to those producers. The Minister has referred the complaint to the Committee of Investigation for England

Bacon Industry Act, 1938: *Amendment of Pigs and Bacon Marketing Schemes.* The Minister of Agriculture and Fisheries and the Secretary of State for Scotland have made the Bacon Industry (Pigs Marketing Scheme Amendment) Order, 1938* and the Bacon Industry (Bacon Marketing Scheme Amendment) Order, 1938† adapting the provisions of the Pigs and Bacon Marketing Schemes respectively so as to bring them into accord with the provisions of the Bacon Industry Act.

Bacon Production Quotas. As from December 1, 1938, bacon curers' sales quotas will be replaced by production quotas. In accordance with the powers conferred on them by Section 29 of the Bacon Industry Act, the Bacon Marketing Board, acting under the directions of the Bacon Development Board, have determined the basis of registered curers' bacon

*S.R. & O. 1938 No. 1,227, price 1*d*. net. and † S.R. & O. 1938, No. 1,223, price 1*d*. net. Obtainable from H.M. Stationery Office, York House, Kingsway, London, W.C.2, or through any bookseller.

production quotas for the period December 1, 1938, to November 30, 1939.

The determination relates only to bacon produced from home-produced pigs and carcasses on premises in respect of which a producers' licence (other than a small curers' licence) is required.

The total quantity of bacon in respect of which production quotas will be issued is the quantity that can be produced from 2,100,000 pigs. For the purpose of production quotas, factories are classified as follows:—(*a*) factories where the quantity of bacon of all descriptions produced (from home and imported carcasses) during any of the three years 1935-37 was more than 5,200 cwt. and (*b*) all other factories to which the determination applies.

The total quota is to be divided between these two classes so that the pigs will be shared between them, as nearly as can be calculated, in the same proportion as the available pigs were divided in 1937.

Pig Contract Prices and Conditions. On September 21, the Pigs Marketing Board, with the consent of the Bacon Marketing Board, determined a form of long contract for the sale of pigs by registered producers to licensed curers for the period of twelve months commencing December 1.

The main form of contract has five variants: Type A (Named Curer) Contract, Type B (Open Offer) Contract; Type C (Group) Contract; Type D (Transferred Pig) Contract, and Type E (Producer-Curers) Contract. The procedure for making contracts is governed by the terms of the Bacon Industry Act and differs from that of previous years. Registered pig producers are invited to offer to sell specified numbers of pigs at specified times on one or other of the first four types of contract. Such offers give the Pigs Marketing Board irrevocable authority to make contracts on behalf of producers for the numbers of pigs and at the time specified in the offers, and upon the prices and conditions circulated with the offer forms and which form part of every type of contract. In making such offers producers must indicate the type of contract to be used by the Pigs Marketing Board when the latter makes contracts with individual curers for the pigs offered. A producer may express a preference for a particular curer, in which case a Named Curer Contract would be used, except that in the circumstances set out in the Statutory Notice published by the Pigs Marketing Board the Board may contract for the pigs to be sold to some other curer; in the latter case a Transferred Pig Contract would be used. Producers who do not wish to nominate a particular curer and who do not wish to take advantage of a Group Contract, will have their pigs allocated to such curers as the Board may decide (acting under directions, if any, of the Bacon Development Board), and an Open Offer Contract will be used. The Group Contract has been revived for the benefit of small producers, but group contractors may not specify the curer to whom the pigs are to be sold. The Producer-Curer Contract is, as its name implies, for the use of curers who produce pigs for the production of bacon, and who wish to offer such pigs on long contracts.

The main details regarding the price to be paid for pigs under long

contracts are laid down in the Bacon Industry Act and are incorporated in the contract conditions.

For a grade B pig in Class I, which is a pig of the weight, quality and kind prescribed by the Minister as a standard pig, a standard price of 12s. 6d. per score will be payable in each month of the year except February and March, when the price is increased to 13s., and in October and November, when it is reduced to 12s. The standard prices are operative when the ascertained cost of a standard ration for pigs is 8s. 6d. per cwt., and will be increased or reduced at the rate of 10·3d. per score for each shilling per cwt. rise or fall in the cost of the ration.

The price of other grades of Class I pigs are higher or lower than the standard price by the amount of the appropriate grade bonus or deduction, which are the same as in the two previous contracts, viz., 6d. per score more for grade A pigs, and 6d per score less for grade C pigs, 1s. 3d. per score less for grade F pigs and 9d. per score less for grade L pigs; for grade D.B. pigs the contract provides for a deduction of 6d. per score from the price of the grade in which it would otherwise fall. Pigs of Class II and Class III weights are to be paid for at 3d. per score less than the price for the corresponding grade in Class I.

Over and above the standard price adjusted according to the ration cost, certain premiums are payable to producers; in the case of a Nominated Curer Contract 6d. per pig where the pig is graded at premises other than those specified by the producer in his offer; in the case of an Open Offer Contract and a Group Contract, 2s. per pig, except that with the latter the 2s is paid to the Group Agent, for his services under the Contract; in the case of a Transferred Pig Contract the premium is 6d. per pig, and in the case of a Producer-Curers Contract 1s. per pig. The price of the standard pig is for delivery free on rail at the nearest railway station, or free on board at the nearest place of loading, but if the producer so elects before the commencement of the Contract, he may deliver the pigs to the curer's premises, in which case the price is increased in accordance with a prescribed scale of allowances. A scale of additions to the price for pigs travelling over 50 miles is also laid down; these are intended to compensate producers for loss of weight of pigs in transit. There is a separate scale for pigs transported by road throughout, which is slightly lower than the scale allowed for pigs transported any part of the journey by rail or sea.

The contract provides for the deduction of 6d. per pig, representing the producer's share of the expenses incurred in effecting an insurance against, or covering any loss incurred by the curer in accepting as contract deliveries pigs which have been damaged in transit or which are found to be suffering from disease which was not reasonably apparent on the farm. A deduction of 6d. per pig is also made when the curer accepts delivery of the pigs at the producer's premises, and there is the usual deduction of 6d. per score from the price of pigs which show black pigmentation after dressing.

The contract provides for three classes of pigs, and differs from previous contracts in that producers cannot contract in Class II which becomes a tolerance class, and Class IV has been discontinued. Producers are allowed a tolerance of 20 per cent. of Class I pigs and 20 per cent. of Class III pigs which may be delivered in Class II, and a tolerance of 15 per cent. of Class I pigs which may be below 7 score and down to and including 6 score 15lb. and a tolerance of 10 per cent. of Class II pigs which may be over 10 score 10 lb. and up to and including 10 score 15 lb.

Grading is to be done by the Pigs Marketing Board graders, and not, as in previous contracts, by the curers with the Pigs Board agents checking

the grading. The grading will be supervised by inspectors employed by the Bacon Development Board

The grade specifications for Class I and Class II pigs are the same as in the voided 1937 contract, but the method of determining the payment grade has been altered. Where either the loin or the shoulder measurement is two or more grades below the other two back measurements, the payment grade is fixed at a grade lower than that indicated by the other two measurements. for example, a pig which graded A at the middle of the back and A at the shoulder, and C at the loin will be graded as a B pig. There is a minor change in the method of grading Class III pigs which operates to the advantage of producers.

The other conditions of the contract relating to delivery, default and miscellaneous details, are substantially the same as in previous contracts. Such alterations as have been made are of minor importance with one exception, namely, that where pigs travel the first part of the journey by sea, the nearest port of loading has been incorporated as the point of delivery, a change which is to the advantage of producers.

Wheat Act, 1932 *Sales of Home-Grown Wheat—Cereal Year,* 1938–39 Certificates lodged with the Wheat Commission by registered growers during the period August 1 to October 7, 1938, cover sales of 4,354,597 cwt. of millable wheat, as compared with 3,748,960½ cwt in the corresponding period (to October 8) in the last cereal year.

Anticipated Supply for the Cereal Year, 1938-39, *and New Quota Payments Order.* The Minister (on the recommendation of the Wheat Commission) has made Orders giving a revised estimate of the supply of home-grown millable wheat in the cereal year 1938-39, and increasing the rate of quota payment which every miller and importer of flour is liable to make to the Wheat Commission in respect of each hundredweight of his output of flour. The Wheat (Anticipated Supply) No. 3 Order, 1938, estimates the quantity of home-grown millable wheat of their own growing that will be sold by registered growers during the cereal year 1938-39 at 31,850,000 cwt. This Order supersedes the Wheat (Anticipated Supply) No. 2 Order, 1938, which gave the estimated supply for the present cereal year as 30,500,000 cwt. By the Wheat (Quota Payments) No. 5 Order, 1938, the Minister has, in the light of estimates furnished by the Wheat Commission, prescribed that the quota payment in respect of deliveries of flour during the period beginning on October 16, 1938, shall be at the rate of 2*s.* 0*d.* per cwt. (equivalent to 5*s.* 0*d.* per sack of 280 lb.). This Order supersedes the Wheat (Quota Payments) No. 4 Order, 1938, under which quota payments were fixed at the rate of 1*s.* 4.8*d.* per cwt. (equivalent to 3*s.* 6*d* per sack of 280 lb.) as from August 11, 1938

Copies of the present Orders—Statutory Rules and Orders, 1938, Nos. 1,225 and 1,226—can be obtained from H.M.

Stationery Office, or through any bookseller, price 1*d*. each, post free, 1½*d*.

Sugar Industry (Reorganisation) Act, 1936: *Annual Report of the Sugar Commission.* The second annual report of the Sugar Commission on the discharge of their functions under the Act during the year ended March 31, 1938, has been published by H M Stationery Office, price 6d. net

Livestock Industry Act, 1937: *Cattle Fund.* The table below gives particulars of the operations of the Fund under the Cattle Industry (Emergency Provisions) Acts, 1934 to 1936, and the Livestock Industry Act, 1937.

	Payments	*Animals Covered by Payments*	*Average Payment per Animal*
April—Sept , 1936	£1,918,488	826,055	£2 6 5
,, ,, 1937	£1,883,067	794,633	£2 7 5
,, ,, 1938	£2,006,114	728,415	£2 15 1

Approval Order under Section 14 The Livestock Commission, with the approval of the Minister, have made an Order approving premises at Swan Street, Spalding, Lincs , to be known as the Spalding Cattle Market, for use as a livestock market in lieu of that formerly held elsewhere in the town

Livestock Advisory Committee Alderman F J Jenkinson, J.P , a member representative of the County Councils Association, has been appointed to the Livestock Advisory Committee, and also designated as a member of the English Livestock Advisory Sub-Committee, to fill the vacancy occasioned by the resignation of Lt -Col Sir Merrik Burrell, Bt , C.B.E

Potato Marketing Scheme: *Board's Report for* 1937-38. The fifth annual report of the Board contains an interesting account of the operations of the scheme during the year ended August 31, 1938.

The report gives detailed information of the numbers of registered producers and the acreages planted, county by county, for each of the five years over which the scheme has operated. A summary shows that the total number of producers registered under the scheme in Great Britain at the end of August, 1938, was 63,853, and that the area planted by such producers had been 537,227 acres. There had been a consistent decline in the numbers of registered producers up to August, 1937, but the figure for the year under review shows a slight increase compared with the preceding twelve months. The acreage, which also declined in the years 1935, 1936 and 1937 has now risen, however, to within 2 per cent. of that pertaining to registered producers in the first year of the scheme.

Allocated as between England (with Wales) and Scotland, the numbers of registered producers in 1938 were 50,527

and 13,326 and the acreages planted 423,768 and 113,459 respectively. There has been no significant alteration in the relative importance of different counties as potato producing areas. The distribution of registered producers according to basic acreage groups and the proportion of the total acreage contributed by each group show fractional variations only from those of the previous year.

Besides the excellent statistical appendices, from which the above facts are drawn, the report provides, as usual, an account of the riddle regulations imposed by the Board during the year and the remainder of the report is mainly concerned with numerous activities which the Board have either continued or ventured upon for the first time.

National Mark Wheat Flour Scheme: *Bakers' and Confectioners' Exhibition*, 1938. In the British Wheat Flour Competition held at this Exhibition this year fourteen entries were received from authorized millers in the National Mark Wheat Flour Scheme in the class for all-English (Yeoman) Wheat Flour milled to National Mark standards The gold, silver and bronze medals offered by the Ministry to the winning entrants were awarded by the judges as under :—

Gold Medal and Diploma	Clark and Butcher, Ltd, Soham, Ely, Cambridgeshire
Silver Medal and Diploma .	Goodacre and Everard, Loughborough, Leics.
Bronze Medal and Diploma ..	Henry Cole and Co. Ltd., Cotswold Flour Mills, Cirencester, Glos.

The gold medal offered by the Ministry to the farmer supplying the largest proportion of wheat used in the winning flour was gained by Messrs. Chivers and Sons, Limited, Histon, Cambridge

The National Farmers' Union offered prizes in Class 60 for the best all-English milk loaf made from National Mark Flour. Entries by 11 firms were submitted, and the prizes were awarded as follows —

First Prize ..	L W. Jenkins, 44, England's Lane, Hampstead.
Second Prize ..	Evans and Co., Chester House, Holyhead
Third Prize ..	F. J. Griffiths, Victoria Bakery, Cwmbran (Mon.).

National Mark Publicity. The Ministry will stage exhibits at the Gloucestershire Root, Fruit and Grain Show, at Gloucester on November 9, and the Norfolk Fatstock Show at Norwich, November 17–19, where a special display of N.M. Turkeys will be on view. At the Birmingham Fatstock Show to be held at the Bingley Hall, November 29-December 2, an office will be available for enquiries in connexion with the scheme for the direct sale of Fat Stock on a Grade and Dead Weight basis.

National Mark Campaign. During the period, November 16–25, a National Mark "Week" will be held at The Hall, Whippendell Road, Watford, at which samples of National Mark produce will be on sale.

County Egg Laying Trials

The main object of the County Egg Laying Trials is to demonstrate the value, from the point of view of egg yield, egg size, seasonality of yield and constitutional vigour, of

selected birds as potential breeding stock for egg production. The Trials have considerable educational value, both locally and generally. They are conducted under official county auspices in accordance with uniform regulations approved by the Ministry.

In the 1937-38 trials, carried out during the 48 weeks ended September 1 last, 8,704 birds were kept under observation in 39 separate counties. The death rate was 16.7 as compared with 7 per cent. of 6,450 birds in 1930-31, there having been a steady increase in mortality in the trials in the intervening period.

The number of birds entered, average production per bird, including production by birds which died, and the mortality of the four principal breeds, were as follows:—

	Number of Birds Entered (Percentage of Total shown in brackets)	*Average Scoring Egg yield per Bird Entered*	*Mortality (Per cent.)*
Rhode Island Reds	4,167 (48)	156·59	15·62
White Wyandottes .	1,336 (15)	148·77	19·99
Light Sussex .. .	1,345 (15)	135·76	15·09
White Leghorns	1,180 (14)	147·99	20·93

The Gold Challenge Cup presented by the Millers' Mutual Association for award to the county whose laying trials show the lowest mortality among the counties entering the competition combined with an average *scoring* egg production per bird entered of not less than 150, has been won in 1937-38 by Holland (Lincs) with a mortality of 10.61 per cent. of the birds entered. The average production of scoring eggs per bird entered in the Holland (Lincs) trials was 150.68.

The counties with the next lowest mortality rate were Hampshire, Durham and Northumberland and Suffolk with 12.50 per cent. deaths, and an average scoring egg production of 161.78, 157.92 and 155.91 respectively.

Imperial Fruit Show

The Imperial Fruit Show, which was opened on October 28 at the Coliseum, Bristol, will be continued until November 5.

Over 150 Bristol fruiterers entered a window-dressing competition on the two days preceding the opening of the Show, and prizes will be awarded to successful entrants by the Ministry's Horticulture Commissioner on November 1.

Retailers' Day, the event for which the Retail Fruit Trade Federation is responsible, takes place on November 2, and

Wholesalers' Day under the auspices of the National Federation of Fruit and Potato Trades Ltd., is fixed for the following day. The "Growers' Day" function, including an invitation luncheon, arranged by the proprietors of the *Fruit Grower* will also be held on November 3.

The Canners' Convention, an event of great importance in the food canning industry, has been arranged for November 2 and 3 by the National Food Canning Council. The Somerset County Council will be responsible for the horticultural-education stand at the Show, and two special broadcasts will be given in the West of England programme.

The High Commissioners for the Union of South Africa, Canada, and Australia will pay official visits on November 1, 2 and 3 respectively.

Prevention of the Introduction of Foreign Pests and Diseases

Every region has its own flora and fauna; and every fauna and flora contains many members that from the point of view of the horticulturist and agriculturist can be regarded only as dangerous, and deserving of confinement within as small an area as legislation and phyto-pathological measures can contrive.

To enable the Minister of Agriculture to take such steps that may be deemed necessary to prevent the introduction into England and Wales of any insect, fungus or other pest destructive to agricultural or horticultural crops and for the prevention of the spread of such pests and diseases in the country, various acts of Parliament have from time to time been passed. The powers conferred under these Acts—the *Destructive Insects and Pests Acts,* 1877 *to* 1927—are exercised by means of Orders made as occasion arises.

The Orders at present in operation affecting the importation of plants from overseas countries are designed, first, to protect the growers in this country from dangerous pests and diseases not already included in its present fauna or flora and against the introduction of which it is necessary to take drastic action, (e.g., the Colorado Beetle) and, secondly, to restrict to the minimum the risk of introduction of those pests and diseases already known to exist in the country (e.g., Wart Disease of Potatoes). As regards this latter class, the chief aim of the Regulations is to prevent the importation of pests or diseases in such numbers or amount as (*a*) to augment appreciably the

existing population of the pest or the amount of the disease, or (*b*) to prejudice the health or subsequent growth of the imported plants or of other plants with which they may come into contact.

Importation of Plants Orders of 1933 to 1938. The basic requirement of the Importation of Plants Orders of 1933 to 1938 is that every consignment of potatoes or of living plants and parts thereof (except seeds) for planting which is landed in England from any country outside the British Isles, the Isle of Man or the Channel Islands, must be accompanied by a certificate of health issued by a duly authorized official in the country in which the potatoes or plants were grown. This certificate states that the potatoes or plants have been thoroughly examined and found to be healthy, no evidence of the presence of any insect, fungus or pest destructive to agricultural or horticultural crops having been found in them. For potatoes an additional clause is required to the effect that no case of Wart Disease has occurred at any time on the land where the potatoes were grown nor within 2 kilometres thereof.

Further additions to this health certificate have been necessitated by reason of the Orders which have been made since the Importation of Plants Order of 1933 was issued, and which prohibit the landing, except under licence, of (*a*) living plants of sugar-beet or mangold, (*b*) living Chrysanthemum plants and parts thereof, and (*c*) living plants and parts thereof of all species of Elm (*Ulmus*) and of the following Conifers:—the genera *Abies, Larix, Picea, Pinus, Pseudotsuga, Sequoia, Thuja* and *Tsuga*, and the certificate must state that the consignment does not contain any specimens of these plants.

The object of these special restrictions on these classes of plants is to guard against the introduction, through the medium of imported produce of:—

(i) Virus diseases of sugar-beet;
(ii) the Chrysanthemum Midge, and
(iii) the so-called "Dutch" Elm disease and other diseases and pests injurious to forestry undertakings

The restrictions on the landing of the "forest" trees mentioned under (*c*) above were imposed at the request of and by arrangement with the Forestry Commissioners.

The spread of the Colorado Beetle in Europe has involved the imposition of additional restrictions on the importation of produce from countries in which this pest has made its

appearance, and the certificates for plants (excepting flower-bulbs) imported from France, Belgium, Germany, Luxemburg and Switzerland must contain a further clause to the effect that the Colorado Beetle does not exist and has not been known to exist within a specified distance (not less than 30 miles) from the place where the produce was grown.

A similar certificate is also required for raw vegetables (excepting cucumbers and mushrooms) and cider-apples imported from these countries during the summer months (early April to mid-October), but, under a General Licence, certain plants and vegetables which by reason of the manner in which they are cultivated are not likely to prove a medium for the introduction of the Colorado Beetle, may be landed under an alternative certificate to the Colorado Beetle certificate. The importation of all potatoes grown in the U.S.A., the Dominion of Canada and European France is, however, entirely prohibited.

Finally, to prevent the introduction of the Apple Fruit Fly —a pest which has proved very troublesome in North America —apples grown in the United States of America may not be landed in this country between July 7 and November 15 unless they are certified by officers of the Federal Department of Agriculture to be one or other of the two superior grades recognized by that Department. Any fruit showing signs of attack by the Apple Fruit Fly would not be likely to pass the sorting and grading to which these classes of apples are subjected.

During 1937, more than 37,000 health certificates were received in respect of consignments of plants, bulbs, potatoes, etc., imported from all sources; this number is slightly larger than that for 1936 and nearly 2,000 in excess of the 1935 figure. The consignments that arrived without health certificates numbered 527 in 1937 as compared with 435 in 1936 and 410 in 1935. Uncertified consignments are detained by the Officers of H.M. Customs and Excise until the plants have been examined by Inspectors of the Ministry. If they are found to be healthy, as is usually the case, they are released to the importer, but the following examples illustrate the kind of action taken by the Ministry, instances where the health of uncertified consignments is found to be unsatisfactory:—

Holland. (*a*) 14,200 English iris bulbs affected with Eelworm. The whole consignment was re-exported.

(*b*) 8,000 gladiolus corms affected with *Septoria gladioli* The whole consignment was destroyed.

United States of America. 500 Tuberoses attacked by Bulb Mites and Penicillium. The whole consignment was destroyed.

Japan. Wistaria trees attacked by scale insects. The trees were released after treatment.

Consignments that arrive accompanied by the prescribed certificates are not necessarily exempt from examination, and arrangements are made at various ports for periodical check inspections of certified consignments. During the autumn and winter of 1937-38 more than 1,800 certified consignments were examined under this arrangement. It is satisfactory to record that the greater part of these were generally healthy and in good condition and that in very few instances was it found necessary to take action under the Orders.

Many of the new potatoes imported during the early months of the year are grown in countries in which the Potato Moth is prevalent. This pest fortunately does not exist in Great Britain, and as a safeguard against its introduction special attention is devoted every year to consignments of potatoes imported from countries where the pest is known to exist. As the result of these inspections during the 1937 season, 14 consignments (1,203 packages) from the Canary Islands and 16 consignments (4,065 packages) from Malta were found to contain tubers infested with the larvae of this moth. Notices were served requiring all these consignments to be re-exported or destroyed.

Similar action, for the same reason, was taken in 1938 in respect of 10 consignments (2,024 packages) from the Canary Islands, 7 consignments (869 packages) from Malta, 6 consignments (1,851 packages) from French Morocco and 1 consignment each from Chile (185 packages) and Bermuda (27 packages).

Apples from North America are also liable to special inspection at the port of entry, and between August, 1937, and February, 1938, some 600 consignments were sampled and examined. One consignment consisting of 121 boxes of apples grown in the United States was found in September, 1937, to contain fruit infested with the larvae of the Apple Fruit Fly and the destruction or re-export of the whole consignment was required. The fact that this is the only case of infestation which has been found since September, 1935, tends to show that the existing regulations are having the effect of preventing the export to this country of apples infested with this pest.

Since the Order prohibiting the importation of Chrysanthemum plants except under licence came into force on April 12, 1937, 52 licences (Holland 30, United States of America 13, Canada and Germany each 3, Australia 2, Denmark 1) authorizing the landing of Chrysanthemum plants have been granted to importers able to satisfy the Ministry that they are in a position to comply with certain prescribed conditions. These conditions require, *inter alia,* that the imported plants should be kept isolated from other chrysanthemums, in a separate greenhouse, and be examined from time to time by an Inspector of the Ministry until all danger of the appearance of the Chrysanthemum Midge has passed. It is satisfactory to note that no trace of infestation with this pest has so far been seen in any plants landed under the authority of these licences.

IMPORTATION OF RAW CHERRIES ORDERS. The regulations affecting the importation of cherries are based on the principle of allowing importations from countries whence fruit infested with the larvae of the Cherry Fruit Fly has been received only up to the date before that on which, in previous years, substantially infested consignments have been detected. As this principle involves the possible modification of the regulations from year to year, the restrictions are not embodied in the Importation of Plant Orders, but are made the subject of separate Orders issued annually.

Samples of imported cherries are taken and examined by the Ministry's Inspectors during the season, and the results of these examinations are taken into account when the terms of the Order to be made for the ensuing season are under consideration. Any discoveries of substantially infested consignments may thus involve an alteration of the date up to which the importation of cherries from the country concerned is permitted in future years.

Under the Importation of Raw Cherries Order of 1938, the entry of *Spanish* cherries was prohibited after May 18, *French* prohibited after May 27, except those grown in a small area around Honfleur; *Italian* prohibited after June 12, except those grown within the Region of Emilia or the Province of Verona, which were allowed to enter until June 23; *German* prohibited after June 26, except those certified not to have been grown south of latitude 53°N. or in East Prussia, and *Hungarian* prohibited after June 9.

Description	Price per ton		Manurial value per ton		Cost of food value per ton		Starch equiv. per 100 lb.	Price per unit starch equiv.		Price per lb. starch equiv.	Protein equiv.
	£	s.	£	s.	£	s.		s.	d.	d.	%
Wheat, British.. ..	5	13	0	9	5	4	72	1	5	0·76	9·6
Barley, British Feeding	5	10§	0	8	5	2	71	1	5	0·76	6·2
„ Canadian— No. 3 Western	6	7	0	8	5	19	71	1	8	0·89	6·2
„ American ..	6	0†	0	8	5	12	71	1	7	0·85	6·2
„ Persian ..	5	18*	0	8	5	10	71	1	7	0·85	6·2
„ Russian ..	6	7	0	8	5	19	71	1	8	0·89	6·2
Oats, English, white ..	7	0	0	9	6	11	60	2	2	1·16	7·6
„ „ black and grey	7	3	0	9	6	14	60	2	3	1·21	7·6
„ Scotch, white ..	9	13	0	9	9	4	60	3	1	1·65	7·6
„ Canadian— No. 2 Western	9	7*	0	9	8	18	60	3	0	1·61	7·6
„ No. 1 Feed ..	7	13	0	9	7	4	60	2	5	1·29	7·6
„ Mixed Feed ..	7	2	0	9	6	13	60	2	3	1·21	7·6
Maize, American ..	7	2	0	7	6	15	78	1	9	0·94	7·6
„ Argentine ..	7	5	0	7	6	18	78	1	9	0·94	7·6
Beans, English, Winter	7	3§	0	17	6	6	66	1	11	1·03	19·7
Peas, English, blue ..	10	10§	0	15	9	15	69	2	10	1·52	18·1
„ Japanese ..	21	10†	0	15	20	15	69	6	0	3·21	18·1
Dari	8	2†	0	8	7	14	74	2	1	1·12	7·2
Milling Offals :—											
Bran, British ..	6	5	0	16	5	9	43	2	6	1·34	9·9
„ Broad ..	6	15	0	16	5	19	43	2	9	1·47	10·0
Middlings, fine imported	6	12	0	13	5	19	69	1	9	0·94	12·1
Weatings, ‡	6	15	0	14	6	1	56	2	2	1·16	10·7
„ Superfine‡	7	2	0	13	6	9	69	1	10	0·98	12·1
Pollards, imported ..	6	5	0	14	5	11	50	2	3	1·21	11·0
Meal, barley	7	15	0	8	7	7	71	2	1	1·12	6·2
„ „ grade II ..	7	2	0	8	6	14	71	1	11	1·03	6·2
„ maize	7	2	0	7	6	15	78	1	9	0·94	7·6
„ „ South African	6	10§	0	7	6	3	78	1	7	0·85	7·6
„ „ germ ..	7	5	0	11	6	14	84	1	7	0·85	10·3
„ locust bean ..	7	15	0	5	7	10	71	2	1	1·12	3·6
„ bean	9	15	0	17	8	18	66	2	8	1·43	19·7
„ white fish ..	15	0	2	4	12	16	59	4	4	2·32	53·0
„ Soya bean (extracted)‡	8	17	1	10	7	7	64	2	4	1·25	38·3
Maize, cooked, flaked ..	7	17	0	7	7	10	84	1	9	0·94	9·2
„ gluten feed ..	7	0	0	13	6	7	76	1	8	0·89	19·2
Linseed cake—											
English, 12% oil ..	10	2	1	0	9	2	74	2	6	1·34	24·6
„ 9% „ ..	9	10	1	0	8	10	74	2	4	1·25	24·6
„ 8% „ ..	9	5	1	0	8	5	74	2	3	1·21	24·6
Cottonseed cake, English, Egyptian seed, 4½% oil ..	5	15	0	18	4	17	42	2	4	1·25	17·3

Description.	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Cottonseed cake, Egyptian, 4½% oil ..	5 12	0 18	4 14	42	2 3	1·21	17·3
Cottonseed cake, decorticated, 7–8% oil	7 12†	1 9	6 3	68	1 10	0·98	34·7
Cottonseed meal, decorticated, 7–8% oil	7 17†	1 9	6 8	70	1 10	0·98	36·8
Coconut cake, 5% oil ..	7 15†	0 18	6 17	77	1 9	0·94	16·4
Ground nut cake, decorticated, 6–7% oil	8 7*	1 8	6 19	73	1 11	1·03	41·3
Ground nut cake, imported decorticated, 6–7% oil	7 7	1 8	5 19	73	1 8	0·89	41·3
Palm-kernel cake, 4½–5½% oil .. .	7 15†	0 12	7 3	73	2 0	1·07	16·9
Palm-kernel cake meal, 5½% oil ..	7 17†	0 12	7 5	73	2 0	1·07	16·9
Palm-kernel meal, 1–2% oil .. .	7 2	0 12	6 10	71	1 10	0·98	16·5
Feeding treacle ..	5 0	0 8	4 12	51	1 10	0·98	2·7
Brewers' grains, dried ale	6 5	0 11	5 14	48	2 4	1·25	12·5
Brewers' grains, dried porter	5 17	0 11	5 6	48	2 2	1·16	12·5

* At Bristol. § At Hull. † At Liverpool.

‡ In these instances manurial value, starch equivalent and protein equivalent are provisional.

NOTE: The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store The prices were current at the end of September, 1938, and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative values of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, if linseed cake is offered locally at £11 per ton, then since its manurial value is £1 per ton as shown above, the cost of food value per ton is £10. Dividing this figure by 74, the starch equivalent of linseed cake as given in the table, the cost per unit of starch equivalent is 2*s*. 8*d*. Dividing this again by 22·4 ,the number of pounds of starch equivalent in one unit, the cost per lb. of starch equivalent is 1·43*d*. Similar calculations will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own markets. The figures given in the table under the heading "manurial value per ton" are calculated on the basis of the following unit prices: N., 7*s*. 3*d*.; P_2O_5, 2*s*. 6*d*.; K_2O, 3*s* 6*d*.

FARM VALUES OF FEEDING STUFFS

The prices in respect of the feeding stuffs used as bases of comparison for the purpose of this month's calculations are as follow :—

	Starch equivalent Per cent	*Protein equivalent Per cent.*	*Per ton £ s.*
Barley (imported)	71	6·2	6 3
Maize	78	7·6	7 5
Decorticated ground nut cake ..	73	41·3	7 17
,, cotton-seed cake ..	68	34·7	7 12

(Add 10*s*. per ton, in each instance, for carriage.)

The Table below is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values," which it is recommended should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows, are given in the November, 1936, issue of the Ministry's Journal, p. 816.)

FARM VALUES

Crop	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent	Per cent.	£ s
Wheat	72	9·6	7 2
Oats	60	7·6	5 18
Barley . ..	71	6·2	6 17
Potatoes .. .	18	0·8	1 14
Swedes . .	7	0·7	0 14
Mangolds . .	7	0·4	0 13
Beans	66	19·7	7 0
Good meadow hay	37	4·6	3 13
Good oat straw .. .	20	0·9	1 18
Good clover hay	38	7·0	3 17
Vetch and oat silage .	13	1·6	1 5
Barley straw	23	0·7	2 3
Wheat straw	13	0·1	1 4
Bean straw . ..	23	1·7	2 4

FOOT-AND-MOUTH DISEASE

The Infected Area around Woolhope, Hereford, referred to in the October issue of the JOURNAL, was released from restrictions on September 27.

An outbreak of Foot-and-Mouth Disease was confirmed at Benenden, Kent, on October 14, and necessitated the declaration of an Infected Area, of approximately 15 miles radius around the infected premises. The area included parts of the counties of Kent and E. Sussex. Two further outbreaks were confirmed at Benenden on October 19.

PRICES OF ARTIFICIAL MANURES

Description		Average prices per ton (2,240 lb.) during week ended Oct. 12.				
		Bristol	Hull	L'pool	London	Costs per Unit ¶
		£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½%) ..	*	8 0*c*	8 0*c*	8 0*c*	8 0*c*	10 4
„ „ Granulated (N. 16%)	*	8 0*c*	8 0*c*	8 0*c*	8 0*c*	10 0
Nitro-Chalk (N. 15½%) ..	*	7 10*c*	7 10*c*	7 10*c*	7 10*c*	9 9
Sulphate of Ammonia: Neutral (N. 20·6%)	*	7 6*c*	7 6*c*	7 6*c*	7 6*c*	7 1
Calcium Cyanamide (N. 20·6%)	*	7 11*d*	7 11*d*	7 11*d*	7 11*d*	7 4
Kainite (Pot. 14%)	§	2 18	2 15	2 15	2 15	3 11
Potash Salts (Pot. 30%) ..	§	5 4	5 1	5 0	5 1	3 5
„ „ (Pot. 20%) ..	§	3 15	3 12	3 12	3 12	3 7
Muriate of Potash (Pot. 50%) ..	§	8 10	8 8	8 5	8 8	3 4
Sulphate „ „ (Pot. 48%) ..	§	10 2	10 0	9 17	10 0	4 2
Basic Slag (P.A. 15¾%) ..	§	2 12*b*	2 5*b*	—	2 10*b*	3 2
„ „ (P.A. 14%) ..	§	2 8*b*	2 0*b*	2 0*b*	2 6*b*	3 3
Grd. Rock Phosphate (P.A. 26-27½%)	§	3 4*a*	3 0*a*	2 15*a*	2 10*a*	1 10
Superphosphate (S.P.A. 16%)	§	3 4	—	3 2*f*	2 19*g*	3 9
„ (S.P.A. 13¾%)	§	3 1	3 2	2 19*f*	2 16*g*	4 1
Bone Meal (N. 3¾%, P.A. 20½%)	§	—	7 5	7 0*h*	6 17	—
Steamed Bone Flour (N. ¾%) P.A. 27½–29½%)	§	4 12*i*	4 15	4 7*h*	4 10	—

Abbreviations: N. = Nitrogen; P A. = Phosphoric Acid; S.P.A. = Soluble Phosphoric Acid; Pot. = Potash.

* Prices are for not less than 6-ton lots, at purchaser's nearest railway station, unless otherwise stated. Unit values are calculated on carriage-paid prices.

§ Prices are for not less than 2-ton lots, nett cash for prompt delivery, f.o.r., in town named, unless otherwise stated. Unit values are calculated on f.o.r. prices.

a Prices for 4-ton lots f.o r. Fineness 85% through standard sieve.

b Prices for 6-ton lots. Prices at Bristol are f o r. Bridgwater; at Hull and Liverpool f.o.r. neighbouring works and at London f.o r at depots in London districts. Fineness 80% through standard sieve.

c For lots of 4 tons and under 6 tons the price is 1s per ton extra, for lots of 2 tons and under 4 tons, 5*s*. per ton extra, for lots of 1 ton and under 2 tons, 10*s*. extra and for lots of 2 cwt. and under 1 ton, 20*s*. extra.

d Delivered in 5-ton lots at purchaser's nearest railway station. For lots of 2 tons and under 5 tons the price is 5*s*. per ton extra, for lots of 1 ton and under 2 tons, 10*s*. per ton extra and for lots of 4 cwt. and under 1 ton, 20*s*. extra.

f Prices shown are f.o.r. Widnes.

g Prices shown are ex works London; f o r. southern rails, 1*s*. 3*d* extra.

h Prices shown are f.o.r. Appley Bridge.

i Price shown is f.o.r. Newport, Mon.

¶ *These are calculated by regarding a ton as comprising* 100 " *units* " (*equal parts of* 22·4 *lb.*) *so that a fertilizer, for example, with* 16 *per cent. nitrogen contains* 16 *such " units " in a ton. Then, if the price per ton of such a fertilizer be divided by the percentage figure, the deduced cost is that of a " unit " of that agent. Those in the table above are based on London prices.* (*For further explanation, see Advisory Leaflet, No.* 146, " *The Valuation of Artificial Manures,*" *obtainable from the Ministry, free of charge.*)

FARM WORKERS' MINIMUM RATES OF WAGES

Agricultural Wages Board. At a meeting held on September 20, 1938, the following Orders were made :—

Gloucestershire.—Fixing as from September 25, 1938, minimum and overtime rates of wages; for adult male workers, head carters: 39*s.* 6*d.* (instead of 38*s.* 6*d.*) per week of 58 hours in summer and 41*s.* (instead of 40*s.*) per week of 60 hours in winter; head shepherds and head stockmen: 41*s.* (instead of 40*s.*) per week of 60 hours; under carters: 37*s.* (instead of 36*s.*) per week of 54 hours in summer and 39*s.* (instead of 38*s.*) per week of 57 hours in winter; under shepherds and under stockmen: 39*s.* (instead of 38*s.*) per week of 57 hours; other workers: 34*s.* (instead of 33*s.*) per week of 50 hours in summer and 48 hours in winter. Provision is made in each case for a reduction in the weekly number of hours in respect of which the minimum rates are payable in the weeks in which certain public holidays fall. The overtime rates for all workers are unchanged at 9*d.* per hour on weekdays and 11*d.* per hour on Sundays and certain public holidays; for female workers of 18 years of age and over the minimum rate for all time worked is unchanged at 6*d.* per hour.

Oxfordshire.—Fixing as from October 3, 1938, minimum and overtime rates of wages, for adult male workers, 35*s.* (instead of 34*s.*) per week of 41 hours in the weeks in which Good Friday, Easter Monday, Whit Monday and August Bank Holiday fall and 50 hours in any other week in summer; 39½ hours in the weeks in which December 24, 1938, and Boxing Day fall, and 48 hours in any other week in winter with overtime throughout the period at 11*d.* per hour (instead of 10*d.*) on weekdays and 1*s.* 1*d.* per hour (instead of 1*s.*) on Sundays and the specified holidays; for female workers of 18 years of age and over the minimum rates remain unchanged at 7*d* per hour with overtime at 9*d.* per hour (instead of 8*d.*) on weekdays and 10½*d.* per hour (instead of 9½*d.*) on Sundays and certain public holidays.

Pembroke and Cardigan.—Fixing as from October 1, 1938, minimum and overtime rates of wages; for adult male workers, 33*s.* (as formerly) per week of 45 hours (instead of 46 hours) in the weeks in which Good Friday, Whit Monday and August Bank Holiday fall and 53 hours in any other week in summer (instead of 54 hours) and 43 hours in the week in which December 26, 1938, falls and 51 hours (instead of 52) in any other week in winter, with overtime at 9*d.* per hour on weekdays, Sundays, December 26, 1938, Good Friday, Whit Monday and August Bank Holiday (instead of 8½d. per hour); for female workers of 18 years of age and over the minimum rate remains unchanged at 5*d.* per hour with overtime payment also unchanged on weekdays at 6*d.* per hour and on Sundays at 6½*d.* per hour for the first three hours and 7½*d.* per hour for subsequent hours.

Radnor and Brecon.—Continuing as from November 1, 1938, the existing minimum and overtime rates of wages; for adult male workers, 33*s.* per week of 48 hours in winter and 54 hours in summer with overtime at 9*d.* per hour; for female workers of 18 years of age and over the minimum rate is 5*d.* per hour with overtime at 6½*d.* per hour on weekdays and 7½*d.* per hour on Sundays.

Copies of the Orders giving full details of the rates, may be obtained free of charge from the Secretary, Ministry of Agriculture and Fisheries, Kings Buildings, Smith Square, London, S.W.1.

Farm Workers' Minimum Rates of Wages

Enforcement of Minimum Rates of Wages. During the month ending October 4, 1938, legal proceedings were taken against 6 employers for failure to pay the minimum rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases follow :—

Committee Area	Court	Fines Imposed	Costs Allowed	Arrears of Wages Ordered	No. of workers involved
		£ s d	£ s d	£ s. d	
Cornwall .	Camborne .	10 0 0	0 14 0	10 1 4	2
,, ..	Penzance .	0 10 0	.	15 0 0	1
Lancs ..	Garstang .	1 0 0	0 10 6	22 0 0	1
Staffs.	Burslem .	6 0 0	2 9 0	40 0 0	1
Worcester.	Alcester	(A)	1 1 0	7 12 0	2
Yorks (W.R)	Bolton-by-Bowland .	(B)		22 0 0	1
	Totals .	£17 10 0	4 14 6	116 13 4	8

(A) Dismissed on payment of costs
(B) Dismissed (Arrears agreed before hearing)

RECENT AGRICULTURAL STATISTICS

Pigs The following is an estimate of the numbers of pigs in England and Wales on September 4, 1938, with corresponding figures for each quarter from June, 1937 .—

	Sows Kept for Breeding '000s	Boars for Service '000s	Other Pigs: Over 5 Months '000s	Other Pigs: 2–5 Months '000s	Other Pigs: Under 2 Months '000s	Total '000s
1937						
June ..	455	32	2,109		1,039	3,635
September	472	33	994	1,634	1,223	4,356
December .	448	32	916	1,688	830	3,914
1938						
March .	453	31	791	1,356	1,104	3,735
June ..	433	30	688	1,526	884	3,561
September ..	450	33	1,016	1,533	1,169	4,201

The number of sows kept for breeding as at September, 1938, decreased, as compared with the corresponding date a year ago, by roughly 5 per cent., but the number of boars used for service was unchanged. In the various groups of "other pigs," those over 5 months increased by 2 per cent., but pigs between 2 and 5 months were fewer by 6 per cent., while those under 2 months decreased by 4½ per cent.

Turkeys. It is previously estimated that on September 4 there were 948,000 turkeys on agricultural holdings over one acre in England and Wales, as compared with 788,000 on June 4, an increase of 20 per cent.

Small Fruit and Minor Crops—In the table below provisional figures are given of the acreage of the various kinds of small fruit in England and Wales in 1938, together with details of the acreages devoted to crops of minor importance.

PROVISIONAL FIGURES OF ACREAGES OF SMALL FRUIT, CERTAIN VEGETABLES, FLOWERS AND NURSERY STOCK AND CROPS UNDER GLASS IN ENGLAND AND WALES IN 1938, WITH COMPARATIVE FIGURES FOR 1937

Crop	1938 (Provisional)	1937	Increase	Decrease
	Acres	Acres	%	%
SMALL FRUIT:				
Strawberries	20,568	21,242	--	3·2
Raspberries	4,661	5,401	–	13·7
Currants, Black	10,035	9,981	0·5	—
,, Red and White	2,361	2,598	—	9·1
Gooseberries	9,331	10,386	—	10·2
Loganberries and Cultivated Blackberries	2,327	2,495	—	6·7
TOTAL ACREAGE OF SMALL FRUIT	49,283	52,103	—	5 4
OTHER CROPS				
Hardy Nursery Stock	10,454	10,196	2·5	—
Daffodils and Narcissi (not under glass)	4,491	4,873	—	7·8
Other Bulb Flowers (not under glass; including area planted for dry bulb trade)	2,628	2,523	4·2	—
Other Flowers (not under glass)	5,907	5,270	12·1	—
Tomatoes, grown in the open	328	282	16·3	—
Tomatoes, grown in glass-houses	1,709	1,561	9·5	
Other Crops (Fruit, Vegetables, Flowers and Plants) grown in glass-houses	1,409	1,081	30 3	—
Other Crops (Fruit, Vegetables, Flowers and Plants) grown in frames	861	521	65 3	—
Celery	6,446	6,063	6·3	—
Rhubarb	7,213	7,376	—	2·2
Asparagus	2,612	2,674	—	2·3
Lettuce, Cos and Cabbage	4,765	4,149	14·8	—
Crops not specified elsewhere	28,406	27,177	4·5	—
TOTAL ACREAGE OF OTHER CROPS	77,229	73,746	4 7	—

RECENT OFFICIAL PUBLICATIONS

Report of Proceedings under the Diseases of Animals Acts for the year 1937. This Report contains a succinct account of the purpose and the effect of Part IV of the Agriculture Act, 1937, which marked the opening of a new chapter in the history of animal diseases administration in Great Britain. Hitherto, the activities of the Ministry in this field had been largely confined to certain scheduled diseases of an epidemic nature, and the action taken had been attended with a considerable measure of success. The new legislation marked the commencement of a large-scale campaign for the prevention and eradication of other diseases, e g., bovine tuberculosis, contagious abortion, etc., that are the cause of the most serious financial losses to the farming community, and for that purpose provided for the centralization of the official veterinary services by means of the establishment of a State Veterinary Service under the immediate control of the Minister of Agriculture and Fisheries, and the transference to that service of all the veterinary functions under the Diseases of Animals Acts and Orders, and under the various enactments relating to milk and dairies, hitherto performed by Veterinary Inspectors of Local Authorities. The Report describes the steps taken to give effect to the transference of those functions which took place on April 1, 1938.

The other outstanding feature of the year under review was the series of outbreaks of foot-and-mouth disease in the eastern and southern counties of England in the autumn and winter months, when 268 outbreaks were recorded. The Report describes the events connected with those outbreaks, the conclusions reached as to their origin and the relation between them and the much more serious and widespread epidemic on the continent of Europe.

With other notifiable diseases the position was satisfactory except for anthrax. There was a substantial reduction in the prevalence of swine fever and the improvement as regards sheep scab was maintained.

The main feature of interest in connexion with bovine tuberculosis was the progress of the Attested Herds Scheme, the rapid development of which is described

The Report states that among the most important of the various measures adopted for the prevention of disease are those relating to the importation of animals. During the year a total of 1,530,257 live cattle, sheep, pigs and goats from Northern Ireland, Eire, Canada, Isle of Man and the Channel Islands were subjected to official veterinary inspection and detention at the approved landing places before dispersal to their destination. The only cases of disease discovered in these animals were 75 sheep affected with sheep-scab and one animal affected with tuberculosis in a form which required its compulsory slaughter under the Tuberculosis Order. In addition, two of the 1,129 dogs imported, all of which were required to undergo the prescribed six months' quarantine, developed rabies during the quarantine period.

In addition to its responsibility for measures relating to animal diseases, the Department is primarily responsible for the administration of regulations designed to protect animals and poultry from unnecessary suffering during transit. In this field of activity the Report describes the circumstances which led to the passing of the Exportation of Horses Act, 1937, which aims at the prevention of the export of horses for slaughter abroad or for short periods of work before slaughter.

The Report also contains information relating to the working of the London Quarantine Station, which exists for the promotion of the export trade in British pedigree stock, and the usual statistical tables showing the

incidence of the notifiable diseases in each county in Great Britain and the numbers of animals imported and exported.

Part VII of the Report contains an account of the work of the Ministry's Veterinary Laboratory and Research Institute at Weybridge, and indicates the wide and increasing scope of the activities carried on at that Institution.

Agricultural Wages (Regulation) Act, 1924: Report of Proceedings, 1936–37. This Report for the year ended September 30, 1937, reviews the work of the Agricultural Wages Board and of the Agricultural Wages Committees, and contains full details of the minimum rates of wages for agricultural workers as fixed by the Committees. In addition, the Report deals with the results of the investigations made by the Ministry's Inspectors for the purpose of securing the proper observance of the minimum rates, and with the state of employment in agriculture and the demand for labour. Price 1*s*. (1*s*. 1*d*. post free).

Agricultural Statistics, 1937, Part I. The statistical material in the Report contains the amplified tables in the same form as for the previous year (1936) and comprises the usual statistics, showing for each county in England and Wales the area and yield per acre of crops, the numbers of live stock and the numbers of agricultural workers. Separate ten-year summary tables in respect of these particulars are given for England and Wales, Great Britain and the United Kingdom. The report also includes the monthly prices and index numbers which, prior to 1936, were published in Part II of the *Agricultural Statistics*. In addition, there are tables of annual average prices and index numbers for each of the past ten years. Price 1*s*. 6*d*. (1*s* 8*d*. post free).

APPOINTMENTS

COUNTY AGRICULTURAL EDUCATION STAFF: ENGLAND.

Lincolnshire (Holland): Mr. N. R. C. Chaplin, N.D.P., C.D.D., has been appointed County Instructor in Poultry-keeping *vice* Mr. G. H. Reed, deceased.

WALES

Cardiganshire: Mr. J. A. George, N.D.P., has been appointed County Poultry Instructor *vice* Mr. H. Powel Evans, deceased.

PROGRESS OF THE LAND FERTILITY SCHEME

The number of applications for contributions under the Land Fertility Scheme received from occupiers of agricultural land in the United Kingdom now exceeds 258,000. The quantities of lime and basic slag in respect of which these applications have been made are approximately 1,799,000 tons of lime and 492,000 tons of basic slag.

WIRELESS TALKS, NOVEMBER, 1938

Station and Date	*Time: p m.*	*Speakers*	*Subject*
National:			
Nov. 3	6.20	Mr. F. Rayns	Winter Fattening of Cattle.
" 10	6.20	Messrs. F. Rayns and J. C. Mann	Problems of Poor Light Land.
" 17	6 30	Mr. F. Rayns	Seasonal Talk.
" 24	6 20	Mr F. Rayns and Major J. Keith	Alternate Husbandry on the Dry Side of England.
Midland:			
Nov. 1	6 25	Messrs. W. A. Stewart (Beef), Clyde Higgs (Milk), and H G. Robinson (Chairman)	A discussion on Single Purpose Cattle.
" 17	6.40	Mr. W. B Thompson	Winter Ploughing and Mucking
North:			
Nov 3	6 40	Professor Hanley and a farmer	A review of farming conditions in the Northern part of the Region in 1938
" 12	—	Eight or nine speakers	Northern Cockpit · Back to the Land
" 17	6.40	Mr W B Mercer	—
Welsh:			
Nov. 4	7 30	Messrs. Percy Ogwen Jones, John Jones, and Trevor Jones.	Cwn Defaid Cymru A conversation on Sheep Dog Trials
" 11	7 30	Mr. E. T. Jones	Place of Oats in Grass Rotation
" 18	7 30	Mr. Moses Griffith and farmers	Stock improvement in Grass Lands
" 25	7.30	Mr. Moses Griffith and Prof. T. W Fagan	Ley Farming
West:			
Nov. 1	6 45	Mr C H Middleton	The Imperial Fruit Show
" 2	7.30	Earl Waldegrave, Messrs. Wilfred Eley and F C. James	Agriculture as a Job The View of the Employer.
" 9	7 30	"	The View of the Employee.
" 10	6.40	—	For Western Farmers.
" 16	7 30	Prof J A. Scott Watson and Viscount Lymington	The Changing Processes of Agriculture. (*a*) Mechanization. (*b*) Research and its Application.
" 23	7.30	Mr. Anthony Hurd and another	The Main Divisions of Agriculture and their Conditions, Grass Land, Arable, Live Stock and Poultry, etc.
" 30	7 30	Messrs John Morgan, C. S. Orwin, and Anthony Hurd	Some Suggested Policies for Agriculture.—I. The Nationalization View.

NOTICES OF BOOKS

From Whippingham to Westminster—the Reminiscences of Lord Ernle. Pp. xx + 327. (London: John Murray 1938. Price 18*s*.)

Those of our readers who recall the tall, spare figure of Mr. Prothero, President of the Board of Agriculture, in the critical last years of the War, will feel an interest in the appearance of this book of reminiscences. It is the last testimony of a man full of years and experience, who after being successively lawyer, editor of a well-known journal, and agent-in-chief to the Duke of Bedford, drifted into Parliament in 1914 at the age of 63, to find himself two years later responsible for the Agricultural Department at the crisis of this country's history Of his wartime experiences in the organisation of food production, there is probably nothing new in Lord Ernle's book. His account differs little from other published records and offers no independent comment or criticism with regard to the play of forces which dominated the scene at that difficult time. There are no "revelations" in this book as far as the wartime period is concerned. Apart from his service with the Board of Agriculture, Lord Ernle will probably be remembered by posterity as the author of "English Farming, Past and Present," which broke new ground and at once took the place which it has since retained as the standard work on English agricultural history.

This book is described as a book of "reminiscences." From early childhood, Lord Ernle had access to the highest circles His home in the Isle of Wight was close to Queen Victoria's residence in the Island, and he was personally known to many members of the Royal Family and household. Indeed, at one time he enjoyed the confidence of the German Crown Princess, who relied on his help and judgment in her difficult years The story of Lord Ernle's life, spent in close contact with the brilliant intellectual and social circles of his time, cannot fail to have an interest for a numerous class of readers. And yet, if it is fair to judge the book as a disclosure of Lord Ernle himself, it will probably be felt by many that the book hardly conveys adequately that sense of charm to which those who knew Lord Ernle testify. It would have been interesting also to have had his views on literature and politics, or some indication of his philosophy of life. "The man himself was finer than anything he said," and if this can be applied to Lord Ernle, the reason seems to be that the book is too restrained; he does not take his reader into his confidence; he is content merely with "reminiscences." And this is all the more to be regretted because Lord Kennett's penetrating and sympathetic introduction leaves no doubt that there was so much more to be said

Report on the Marketing of Linseed in India. Pp. xiv + 352. (Delhi: Government of India Press, 1938. Price 2*s*.)

This is the eighth of the Marketing Series of reports issued by the Office of the Agricultural Marketing Adviser to the Government of India.

Linseed is widely cultivated in India. It is an important cash crop, only about one-fifth of the output being retained in production areas. The rest is sold for manufacture into oil and oil-cake, either in primitive country "ghanis" or in power mills. About half of the manufactured output is exported, and it constitutes an important item in India's trade. Argentina occupies a dominant position in the world market, furnishing 80 per cent. of export supplies; India ranks second with about 16 per cent. Since the Ottawa Agreement of 1932, the United Kingdom has taken about two-thirds of India's total exports of linseed.

The report gives a very full account of the existing conditions of production, manufacture and marketing of Indian linseed. The conclusions are based on the recognition of the fact that the price of linseed is limited by the competition of other vegetable oils and, in the export market, by the competition of other countries, especially Argentina. "The main problem therefore is to secure for growers a larger percentage of the price which buyers are prepared to pay." At present the growers receive five-eighths of the price paid by the exporter, and little more than half of that paid by the United Kingdom buyer.

The recommendations include the institution of regulated markets, similar to those already existing in certain provinces for cotton and other commodities, with provision for the licensing of dealers and the control of market charges; improved market intelligence services for producers; various measures to reduce the seasonal depression of prices at harvest time; the standardization of weights and measures; the prevention of adulteration; the general adoption of an all-India contract (already agreed between the Central Marketing Staff and trade organizations) providing for a fixed scale of premia and discounts for different types of linseed; the distribution of improved seed; and the organization of Indian manufacturers with the objects of improving the marketing of their produce, and of advertising it in export markets.

The reading of this voluminous report is made easier by summaries at the end of each chapter. It includes numerous illustrations and graphs, a mass of statistical data, and examples of contracts used by the trade.

General Plant Physiology. By E. C. Barton Wright, M.Sc. Pp. 539 and 44 diagrams. (London: Williams & Norgate, Ltd. 1937. Price 15*s*.)

The number of papers on plant physiology which have been published during the past 15 to 20 years is so large, and many of them are so specialized, that anybody who attempts to write a textbook on the subject is undertaking an arduous task. In consequence of this difficulty, until comparatively recently when several books on the subject have appeared, those specializing in other branches of botany have had no standard work to consult when wishing to consider their own problems in the light of modern physiological developments. The book under review should, therefore, be one of several which will be welcomed by students. The book is divided into three main parts. These deal with "The General Physiology of the Cell," "Metabolism" and "Growth, Reproduction and Irritability," respectively. There are also an appendix on "The Conception of pH," a bibliography, and separate indexes to authors and subjects.

Generally speaking, the subject matter is well balanced, carefully chosen, clearly presented, and, considering the comparatively small size of the book, remarkably complete. Besides the literature cited in the bibliography, references to original papers are also given as footnotes, but it is rather unfortunate that these do not include all the authors who are mentioned, as it is not clear in many instances where further information is to be found. There are also a few other points which call for correction. For instance, the paragraph on p. 401 dealing with Christoph's work on the germination of Ericaceous seeds is very obscure, because some confusion between seedlings and cuttings appears to have been made. Such small points, however, do not seriously detract from a very useful book on plant physiology which can be recommended to students and others who require a brief outline of the existing knowledge of this subject.

NOTICES OF BOOKS

Das Dämpfen und Einsäuern von Kartoffeln (*The Steaming and Ensilage of Potatoes*). By Dipl.-Ing. Bruno Victor and Dipl.-Ing. Heinrich v. Waechter. Pp. 68. (Neudamm: J. Neumann. 1937. Price RM. 1.50.)

As a part of the German four-year plan for national self-sufficiency, the authors advocate the preservation of potatoes for fodder. A preliminary section sets out the case for storing and preservation, with details of potato harvests and consumption in Germany. Then follow descriptions of processes and apparatus for washing and steaming potatoes prior to storage in silo pits. The apparatus, of which there appear to be several makes on the market, is described as a *Dämpfkolonne* ("steam column") which can be assembled into a mobile unit for transport by horse or motor vehicle. The machines can thus be taken easily from place to place, and serve small-holdings and farms where the purchase of the apparatus would not be economically sound. Figures are given of operating costs for the process, which are, of course, based on costs of material and wages applying in Germany. The book is obviously intended for German farmers, but the machinery and processes described might well have a wider interest.

Danish Agriculture: Its Economic Development. By Einar Jensen. Pp. xvii+417. Illustrated. (Copenhagen: J. H. Schultz Forlag. 1937. Price $3.75.)

It is almost impossible to understand the economic environment of a modern nation without some knowledge of the historical development which has given rise to that environment. The problems of modern societies are too often attacked as if they were isolated in time, and were not closely linked with the problems which had arisen in previous times. Frequently indeed they are a direct result of the solutions that have been applied to those earlier problems.

Dr. Jensen's book is the more interesting because it illuminates this characteristic of economic problems generally, and explains how it is that Denmark has apparently remained a reasonably prosperous society in a period during which the rest of the world has been afflicted with difficulties.

The early chapters dealing with the economic history of Denmark from early times shows how the social history of the nation led to the creation of a tendency amongst the peasants in a former period to co-operate for the purpose of holding their own in society. This was partly a result of a conflict between the crown and the nobility aiming on the one side at the preservation of a numerous and well-to-do peasantry, and on the other, to reduce it to an agricultural proletariat. The result was the growth of a social organization favourable to the later development of co-operative undertakings, a development directly contrary to what happened in this country where the social organization and the legislation tended at once towards the creation of rugged individualism curiously combined with unprotected servility.

The quasi-natural tendency of the Danish character towards co-operation which historical events had developed was fortified by the activities of the folk schools which were established in the 19th century and the position of the peasantry was strengthened when the suffrage was given to them, so that they emerged as a strong political class, well-to-do and numerous enough to play a major part in deciding upon the measures that should be taken by their government.

Fortunately perhaps, for the Danish farmers, the country did not possess the natural resources that would enable it to become fully industrialized, and so the firm basis of its wealth was farming. The technical and scientific progress made in agricultural processes during the 19th century are well known and need no recapitulation here. Dr. Jensen does, however, deal

with their adoption in Denmark as he does with the changes in emphasis on the various branches of farm production in accordance with the demands of world economy.

The adjustments which the Danish people have made in order to fit into a world economy have been so successful that, in Dr. Jensen's words, " It represents a successful adjustment to the character of the natural resources, and, although there is much room for the further development of these resources, there are really no important alternatives." This is a consummation of which many other countries are justly envious, and which many are to day doing their utmost to achieve

Rothamsted Experimental Station Report, 1937. Pp. 225. (Obtainable from the Secretary, Rothamsted Experimental Station, Harpenden.) 1938. Price 2*s*. 6*d*

Farmers and their technical advisers will find a great deal of useful information on crop production and the use of fertilizers in the present issue of the Rothamsted Report.

The volume contains the full data relating to the numerous field experiments carried out at Rothamsted and many outside centres, and also valuable summaries of groups of experiments dealing with special subjects. Although farmyard manure is by far our most important soil improver, its effects have not been measured nearly so frequently as those of artificials. All the available experiments with dung have been collected in the present report. They bring out its direct effect on potatoes, sugar beet and kale and its residual action on the following crops of cereals. An important point illustrated is the effect of the presence of dung on the action of artificial fertilizers. A further section sets out the main results of 107 fertilizer experiments on sugar-beet carried out during the past four seasons on a uniform plan in all the important beet-growing districts. Salt, one of the oldest of manures, has recently been carefully studied in its effects on sugar-beet and mangolds. Its action has usually been very favourable on these crops, and evidence on this point is collected from a number of centres. Under the present regulations for the sale of potatoes the size of the tubers is of considerable importance, and a review of the effects of manures on the proportion of ware potatoes is given. Liming experiments are also reported which show that in certain soils the effect of even a light application of chalk can persist throughout a long rotation.

A full account of the laboratory work is given, supplemented by abstracts of recent papers. In the Chemical Department the numerous field experiments have provided material for the study of analytical methods for estimating the manurial requirements of soils, and particular attention is being devoted to rapid methods of soil analysis. Perhaps one of the most interesting aspects of the biological work is the study of strains of the nodule organisms of leguminous plants. Some of these strains instead of being beneficial have been shown to be actually parasitic and in addition they are so aggressive that they can displace many of the strains that show the usual beneficial action on the plant. Fortunately certain strains have been discovered that are both beneficial and also capable of competing with the worthless strains.

The report contains a summary of twenty years' work in the Department of Plant Pathology in which the contributions relating to the study of Wart Disease of Potatoes, Take-all disease of Wheat and the group of Virus diseases are set out with full references.

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NOTES FOR THE MONTH

Milk Industry Bill

The Bill to give effect to the Government's proposals for the assistance and better organization of the milk industry outlined in the White Paper on Milk Policy (Cmd. 5533) issued in July, 1937, and amplified in certain respects in a subsequent statement of policy made by the Minister of Agriculture and Fisheries on December 7, 1937, was introduced into the House of Commons on November 16.

The Bill provides for the establishment of a non-representative Milk Commission charged with the duty of keeping generally under review all matters relating to the production, distribution and consumption of milk and milk products, and of advising and assisting Ministers in relation to such matters. The Commission will also be entrusted with certain other specific duties, particularly in relation to measures for securing greater efficiency and economy in milk distribution, and also the exercise of functions of conciliation and arbitration, at the invitation of the parties, in the event of disputes between boards or between a board and other parties to negotiations. The Commission will be assisted by a Milk Advisory Committee on which the various sections of the industry will be represented.

The Bill includes provision for encouraging the production of clean and pure milk in Great Britain over a five-year period commencing retrospectively from October 1, 1938. It is proposed to make contributions to milk marketing boards from the Exchequer, at rates to be determined by Ministers by Order, and corresponding to those foreshadowed in the

White Paper, towards premiums paid or credited by boards to producers of quality milks, i.e., Accredited and T.T. Milk and milk from Attested Herds, and the equivalent Scottish grades.

It is proposed, as an extension of similar powers in the Milk Acts, 1934 to 1938, to enable Ministers to make payments to milk marketing boards from the Exchequer in respect of losses incurred on milk sold up to the end of September, 1943, to school children and to mothers and young children under approved arrangements for increasing the demand for milk on the part of these classes of consumers.

In addition, provision is made for safeguarding the industry against the effect of any serious fall in the prices of butter and cheese. The Bill provides for payments from the Exchequer in respect of milk used for the manufacture of these products, including milk made into cheese on farms, up to maxima for Great Britain of 125,000,000 gal. of milk per annum for each product, in the event of average prices of imported butter and cheese, as ascertained by Ministers, falling over specified six-monthly winter and summer periods below 120*s*. and 112*s*. respectively as regards butter, and 67*s*. 6*d*. and 62*s*. 6*d*. respectively in respect of cheese. Provision is made for the review at three-yearly intervals of the standard prices and the maximum gallonages on which payments may be made.

It is proposed, as a further safeguard, to seek additional powers for the Board of Trade to regulate imports into the United Kingdom of milk and milk products if it appears desirable in order to secure the stability of the United Kingdom market for milk or any milk product.

Provisions designed to facilitate the improved organization of the milk distributive service are contained in the Bill. It is proposed to require the Milk Commission to investigate the costs of distribution and to enable it, in the interests of efficiency and economy, to regulate certain specified aspects of the distribution of milk and cream. The Bill enables the Commission to submit to the Ministers schemes for the organization of the distributive side of the industry, prepared either by distributors themselves or by the Commission after consulting them; such schemes may contain provisions enabling the boards administering them to perform functions of service to milk distributors generally and in particular to determine distributive margins and to undertake, if so authorized by the Minister, regulatory functions of the Com-

mission. Producer-retailers would, however, remain subject to milk marketing boards. The public safeguards (Consumers' Committees and Committees of Investigation) provided in regard to agricultural marketing schemes under the Agricultural Marketing Acts will be applied to any distributors' schemes. The Bill further enables the Commission, on the basis of proposals submitted by interests in the industry, to submit to Ministers not more than ten local rationalization schemes, providing for the supply of milk in the area concerned by specified persons in a manner calculated to bring about greater efficiency and economy. Such persons would be required to undertake appropriate obligations under the scheme, including the payment of compensation to persons who suffer damage by reason of its operation. Provision is made for consultation with the Milk Advisory Committee, local authorities and other local interests concerned, for the holding of inquiries into objections and for the schemes to be approved by Parliament.

It is proposed to enable the Minister of Health (or the Department of Health for Scotland) on the application of a local authority, and if the Minister or Department after consultation with the Milk Commission sees fit on considering the circumstances of an application, to make pasteurization orders, prohibiting the sale by retail in the area concerned of milk that is not either pasteurized, sterilized or tuberculin tested (or certified in Scotland). The Bill provides that no such prohibition shall come into force at a date earlier than 2 years after the making of the Order, and that retailers in the area deriving 80 per cent. of their supplies from a single herd may secure exemption for such milk for a further three years after the prohibition would otherwise operate. The Bill requires a local authority to give at least four weeks' notice of its intention to apply for an Order, and provides for the holding of an inquiry into objections to such a proposal.

The Bill further provides for the appointment by the Milk Commission of a Research Committee consisting mainly of representatives of the industry, together with scientific members, and for the expenditure by the Commission, out of a fund contributed by sections of the industry likely to benefit, of monies for research purposes or for the promotion of milk sales, in accordance with proposals approved by the Research Committee or by the sections of the industry concerned, by the Commission and by Ministers.

Agriculture and the United States-United Kingdom Trade Agreement*

A comprehensive Trade Agreement between the United States and this country was signed on November 17, 1938. The Agreement is for an initial period of three years.

The United States have agreed to lower rates of duty over a wide range of goods, mainly industrial. Few of these are of direct interest to the United Kingdom farmer, although it may be noted in passing that the United States concessions include lower duties on such commodities as rye grass seed and mustard seed, and certain classes of horses.

On our side, concessions have been made both on industrial goods, raw materials and food products, but United Kingdom producers of certain agricultural commodities on which concessions have been made, are protected by measures other than tariffs.

The following are the principal agricultural commodities affected by the Agreement:—

1. *Wheat.* The duty of 2s per quarter on foreign wheat has been removed. This concession mainly affects the Dominions, since the position of the United Kingdom farmer is safeguarded by the Wheat Act. It is, moreover, important to note that no concession has been made on flour. This may well lead to an increase in the milling of foreign wheat in the United Kingdom and a consequent increase in the supply of wheat offals

2. *Maize.* Maize, except flat white, is already guaranteed free entry under the Argentine Agreement until December 31, 1939. The United States Agreement extends this conventionalization of free entry at least until December, 1941. This prolongation of freedom from duty on an important feeding stuff is of particular interest to poultry keepers.

3. *Pigs Products.* Duty-free entry for hams is to be maintained and the quota increased. The home industry will not be affected as it is safeguarded by the Treasury guarantee under the Bacon Industry Act. After three years, the United Kingdom Government regains the right to modify these concessions The 10 per cent. duty on lard has been abolished—a concession which the Government recognize will affect the curers' statutory working margin under the Bacon Industry Act, the Government have this matter under consideration.

4. *Apples and Pears.* Reductions of 1*s.* 6*d* per cwt. have been made in the Ottawa duties. As regards apples, the new rate (3*s.* per cwt.) will still have an incidence of over 15 per cent. *ad valorem.* An exchange of letters attached to the Agreement records an undertaking by the United States Government to call the attention of their exporters to the desirability of co-operating with the Empire Fruits Council in securing orderly marketing of supplies to the United Kingdom.

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* Copies of the Agreement (Cmd. 5882) may be purchased directly from H.M. Stationery Office, or through any bookseller, price 1*s.* 6*d.* net.

5. *Other commodities.* Other reductions in duty are of less importance to the British farmer, but they include honey, from 7*s.* per cwt. to 5*s.* per cwt.; canned loganberries, from 15 per cent. to 4*s.* per cwt. (equivalent to about 10 per cent.); oatmeal, from 7*s.* 6*d.* per cwt. to 5*s.* per cwt.; and certain reductions on canned apples and dried apples, pears and peaches.

As regards industrial articles, imported into this country, the principal item of interest to farmers is the reduction in duty from 33⅓ per cent. to 25 per cent. *ad valorem* on agricultural track-laying tractors and the guarantee not to raise the existing 15 per cent. duty on wheeled tractors.

From the foregoing it will be evident that the surrender of advantages at present enjoyed by agriculture in the United Kingdom is not of a very serious nature. Moreover, among the general provisions of the Agreement there are clauses that enable action to be taken to impose additional duties if any scheduled products are dumped or are subsidized upon exportation, and there are other clauses which provide freedom of action for the institution of quantitative regulation of imports in connexion with a marketing scheme or other measures operating under Governmental authority which are designed to control production, market supply, quality or price of the domestic article, and for a revision of the import duties on any products in respect of which it is found that the reduction in the duty under the Agreement is benefiting any third country rather than the country in whose favour the reduction was made.

GRASSLAND IMPROVEMENT

A BRIEF ACCOUNT OF EXPERIMENTS CARRIED OUT ON THE RT. HON. EARL DE LA WARR'S BUCKHURST ESTATE IN SUSSEX

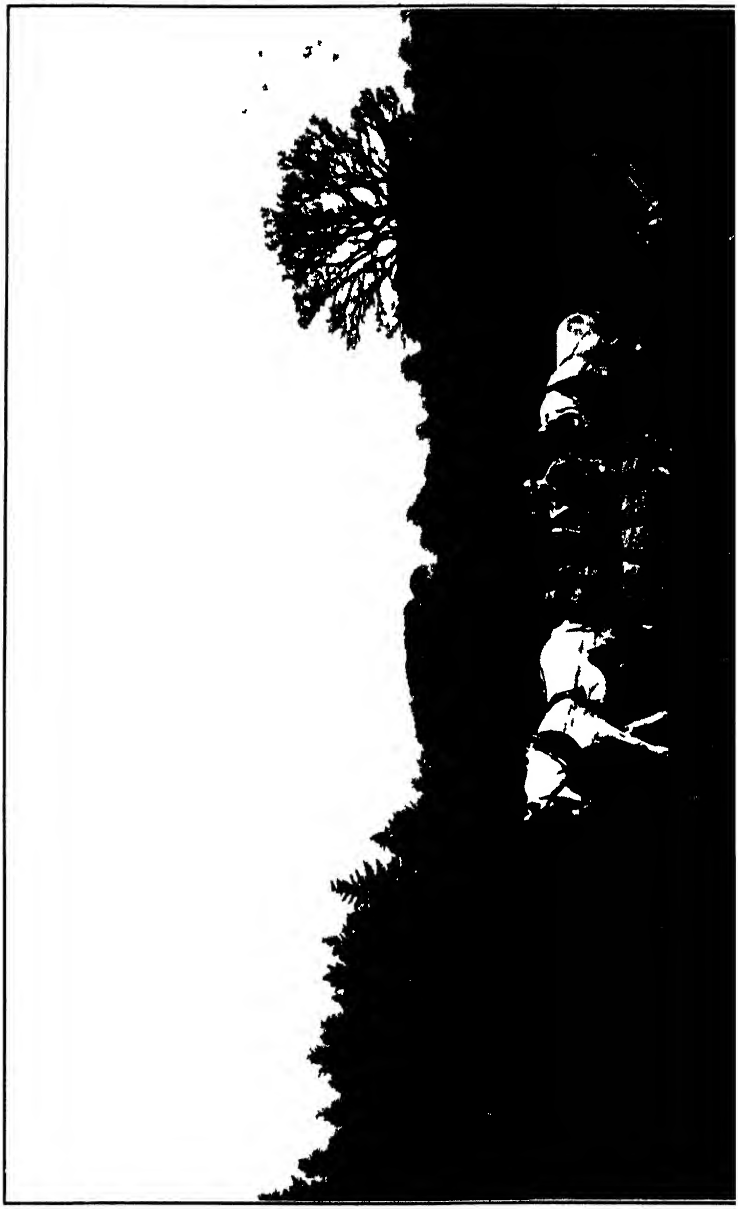
H. J. PUSEY

Buckhurst Farm, comprising about 500 acres, is situated in East Sussex, is about eight miles from Tunbridge Wells and borders upon the Ashdown Forest, an infertile common of several thousand acres growing little but heath and bracken.

During 1916, owing to war-time necessities, about 150 acres of inferior park land were ploughed up, corn was grown at great expense, and, speaking generally, yields were disappointing. The close of the War brought with it the problem of the future of this land—should it revert to what it originally was, or should something more ambitious be attempted? Lord De La Warr, always keenly interested in agriculture, was in favour of making this land pull its weight in our national economy, so in 1922 there began the great adventure of converting this worn-out park land into a useful farm.

The grass land left untouched during the War was now given serious consideration. Careful examination showed the soil to be a shallow, medium loam on sandstone, with the sandstone in many cases much too near the surface for our liking, and deficient in lime and phosphates. Of the grasses growing on the land, Yorkshire Fog and Bent Grass (*Agrostic*) predominated, whilst ragwort, bracken, and most other weeds indigenous to this class of soil could everywhere be found.

The presence of large anthills, in some instances literally covering the whole of a field, brought us face to face with our first problem in cultivation. They were so large that they threatened to overturn any tractor, or at least to break its springs. We overcame this difficulty by hitching a three-furrow tractor plough in such a manner that it ran wide of the tractor, and by running round the field in the way one does with a mowing machine, the tractor with the three-furrow plough set at ground level was able to cut off and break up most of these anthills, leaving them in a condition in which heavy harrows or disc harrows could finish them off and at the same time cultivate the turf. Having thus aerated the



To face page 870

turf and dragged out as much of the old "taw" as possible, and attended to the drainage where necessary, the manuring of those fields which had been taken in hand was proceeded with. Basic slag and kainit at the rate of 10 cwt. and 4 cwt. per acre respectively were applied during the winter months.

The following spring and summer showed a decided improvement, and wild white clover began to flourish naturally. We fostered this improvement by careful and systematic grazing.

Although the effect had been considerable, we were not wholly satisfied; the ragwort and bracken had suffered from continued cuttings, but the grasses were still of poor quality. The Yorkshire Fog and the Bent Grass were still prevalent, but, what was more disappointing, the spring growth was very late; even where heavy dressings of farmyard manure had been given, there never was a good bite before the end of May even in a favourable spring. Top dressings of fertilizers such as slag may encourage clover, but clover is a late starter and it practically disappears in winter. In our case the grass species for the most part remained the same, late and comparatively unpalatable in summer and almost uneatable in winter. One pasture of 20 acres which had been treated in this way, and had a seed mixture sown in addition, gave no response to our efforts, in fact its condition to-day is much the same as when it was first taken in hand some years ago.

Our experience in farm costings had taught us that "the early bite" was an essential economy of farm management, and if one could get a "late bite" also at the other end of the grazing season, so much the better. How could this "early bite" be obtained on land so unfavourable? We thought the answer was forthcoming. We were aware of the successful experiments in grassland improvement being carried out at the Cahn Hill Experimental Station, Aberystwyth, by Professor Stapledon, so in October of last year we had the pleasure of paying the Station a visit, hoping to find in what we might see there a solution of our own problems. We were greatly impressed with the results achieved on such unpromising land with the aid of the plough and the help of the special grasses that had been bred at the Welsh Plant Breeding Station, and returned home determined to experiment on similar lines with some of our grass land that had not fulfilled expectations.

Forty acres of pasture that had already been subjected to the treatment described above were selected for these further

experiments, and ploughing by tractor was commenced early in January. The land was ploughed to a depth of 5 in. in order to get comfortably below the old turf, but at this depth difficulty was found in making a good ridge with the tractor, so ridges and open furrows were done with a horse plough. The land was left in furrow until the first week in April, when it was disc harrowed both ways. One ton of ground burnt lime (52 per cent. CaO)was then sown (basic slag also was to have been sown, but as at that time it was unobtainable, we had to proceed without it) and disc harrows and tine harrows were used until a sufficiently fine tilth was obtained.

In the meantime Professor Stapledon's advice as to seeds had been sought, and the following mixture was sown by hand barrow at one operation.

Italian Rye Grass	15 lb
Irish Perennial Rye Grass	6 ,,
Perennial Rye Grass, S 23	10 ,,
Rough Stalked Meadow Grass	1 ,,
Cocksfoot, S 26	7 ,,
Broad Red Clover	2 ,,
Montgomery Late Flowering Red Clover	2 ,,
Kentish Wild White Clover	1 ,,
	44 ,, per acre

The S 23 Rye Grass and the S 26 Cocksfoot are both leafy strains which do not readily run to seed, and are products of the Welsh Plant Breeding Station

The seeds were covered by chain harrowing and rolled twice with a heavy Cambridge roll. Owing to the prevailing dry weather, we were unable to consolidate the ground to our satisfaction.

The drought continued, and by the middle of May (the sowing was made early in April) there were no signs of germination; however, on May 18 we had a few hours of rain, and within seven days the whole aspect had changed, what had been bare land rapidly became green again. Thunderstorms in June and July completed the good work, in fact, the grasses grew so fast that we feared they would get out of hand and so defeat our efforts to form a good turf. Sheep were put on in June, and the mowing machine had to be used the first week in July, for by then the grasses had made too much growth. Fifty-two cows were then turned in, and again in August the mowing machine was run over. The 200 lambs and fifty-two cows grazed the forty acres at intervals until the end of October, when wet weather having set in it was

considered advisable to discontinue the grazing for fear of treading the seeds too badly. The heavy grazing and the mowing have benefited the seeds and already quite a good turf has been formed.

Local farmers who have inspected the experiments have invariably commented favourably on the result attained, and many have expressed the opinion that the seeds have the appearance of having been down two years at least.

The basic slag we were unable to obtain in April was applied in October at the rate of 6 cwt. per acre.

If the crop fulfils the promise it at present shows, we confidently anticipate being able to get our "early bite" next spring, if possible grazing to the middle of May, then closing the fields and taking a hay crop at the end of June.

As yet it is early days in which to formulate definite conclusions, but we feel convinced that the new pastures will carry a much heavier head of stock, and that the grazing period will be lengthened considerably.

We think the lime played a large part in establishing the seed mixture. Possibly, residues from the previous improvements were an assisting factor. If this be so, then our theory is that poor quality grasses cannot take full advantage of an adequate manuring, whereas the better kinds are able to do so. The point that has really impressed us is that whereas the old system of pasture improvement—slagging, aerating the soil, etc.—tried out in this instance over a period of 15 years or so, which brought about only a slight improvement, in the long run costs but very little less than doing the job thoroughly with the plough and getting a result two or three times as good in a much shorter period.

We look to the future with the greatest interest, and meanwhile we are arranging to extend the experiment to a further acreage this winter.

GREEN FODDER FOR PIGS

Charles Crowther, M.A., Ph.D.,
Harper Adams Agricultural College

A great and growing part of our modern livestock husbandry is based upon an abundant supply of cereals and other concentrated feeding stuffs. Any serious curtailment of existing supplies of this class of material would involve either a reduction in the scale of operations or a considerable modification of existing practices. This difficulty would immediately affect a very large part of our pig husbandry, which is now based almost entirely upon meal feeding.

The problem of finding adequate substitutes in a time of emergency, or for purposes of policies of national self-sufficiency, has been receiving special attention for several years in Germany and other Continental countries, and has also been securing increasing notice in our own country with the development of the grassland campaign.

It is now generally agreed that even for peace-time conditions some reduction of our dependence upon imported supplies of feeding stuffs is desirable, whilst in time of war the grain produce of our home acres would probably be for the most part required for direct human consumption and only a mere fraction would be available as grain and milling " offals " for the feeding of live stock.

Substitutes would have to be sought, therefore, amongst the various other products of the farm, such as roots and greenstuffs, which are either of no direct use to the human being or are less vitally necessary to him than a full supply of cereals.

Foremost amongst these, and probably the most easy to provide in quantity in all parts of the country in times of emergency, is the produce of grass land, supplemented by greenstuffs from the arable. In arable districts, considerable supplies of roots surplus to human requirements would doubtless also be available, but, taking the country as a whole, the maintenance of the head of live stock in general, and of pigs and poultry in particular, would depend upon the extent to which greenstuffs could be made to eke out successfully the reduced supplies of cereals and other concentrates.

GREEN FODDER FOR PIGS

This article is concerned solely with the pig, and its purpose is to review the information now available as to the extent to which the pig can meet its nutritive needs from greenstuffs.

That even a small supply of greenstuff, insignificant in proportion to the pig's total food supply, will stimulate the appetite and have a beneficial effect upon the general health of the pig will hardly be disputed, but for our present purpose it is the maximum rather than the minimum supply that interests us, and what we want to know is how much greenstuff the pig can efficiently dispose of if required, and what saving in supply of concentrated foods can thereby be effected.

First, a word of "theory" as to the general composition and nutritive characteristics of grass and other common greenstuffs. It is common knowledge that they contain a large and variable proportion of water, and their variability in this respect makes comparisons of their composition difficult unless the water factor is eliminated by expressing the composition in terms of percentages of the dry matter, as in the appended Table, which is based upon the average figures for the various materials given in *Rations for Livestock* (Bulletin No. 48 of the Ministry).

Greenstuff	Moisture	Percentage in Dry Matter				
		Crude Protein	"Oil"	Soluble Carbo-hydrates	Fibre	Ash
	Per cent					
Pasture Grass (Close grazed)	80	20	5	47	19	9
,, ,, (Long)	83	13	4	50	23	10
Red Clover (in flower)	81	18	4	42	27	9
Lucerne ,, ,,	76	17	2	41	30	10
Vetches ,, ,,	82	18	3	41	29	9
Cabbage (Drumhead)	89	14	3	54	18	11
Kale (Thousand-head)	84	14	2	53	20	11
,, (Marrowstem)	86	16	4	49	18	13
Rape	86	20	5	40	25	10
Mustard	81	19	3	49	20	9
Sugar-beet Tops	84	13	3	54	10	20

It will be seen that there is a considerable general resemblance in the composition of the dry matter throughout the materials tabulated, and for purposes of general discussion a rough average percentage composition of the dry matter of greenstuffs might be taken as 17 protein, 3 oil, 47 soluble carbohydrates, 22 fibre and 11 ash. They are thus about as

rich as weatings in crude protein and "oil," richer in minerals and much higher in fibre.

The comparatively high figure for protein is rather misleading, since about one-fifth of it consists of "amides" which the pig is unable to use for the specific purposes of protein supply. Even after allowance is made for this, however, the true protein content of the dry matter of greenstuffs still remains substantially higher than that of cereals. The "oil" figure also needs to be discounted to a similar extent, since it includes a proportion of material that is not true oil.

The minerals of greenstuffs are valuable both in amount and in kind, since they are rich in the basic ingredients, lime and alkalies, and thus help to offset the acidity of the cereal meals. Their content of vitamins A and D, which is not shown by the ordinary analysis, must also be accounted to them as a valuable asset.

So far, therefore, the greenstuffs would seem to be excellently designed to serve as pig food. Their one drawback, which imposes a rather narrow limit upon their use, is their richness in fibre. Not only is the pig's power of digesting fibre much lower than that of the ruminant but, owing to the imperfect breaking-down of the cell walls of the fodder that this implies, the proteins and carbohydrates are less fully exposed to the action of the digestive juices and consequently the digestibility of the fodder as a whole is lowered. Thus, Woodman obtained the following digestion co-efficients for very young grass fed to sheep and pigs respectively:—

	Sheep %	*Pigs* %
Crude Protein	85·4	66·6
Ether Extract ("Oil") . ..	60·0	--
Sol. Carbohydrates, etc ..	87·4	71·2
Fibre	79·2	56·9
Total Organic Matter . ..	83·6	61·9

It will be seen that, even with this soft type of material, the pig digested from it only about three-quarters of the material that the sheep was able to extract. Similarly, in tests recorded by Kellner, the sheep digested 68 per cent. of the organic matter of red clover cut on the point of flowering, whereas the pig digested only 40 per cent.

More serious, however, than their comparatively low digestibility is the bulky character of the fodders. The capacity of the digestive system of the pig is relatively small and if,

therefore, a considerable part of this is taken up with fodder which, being bulky, is of low energy concentration, it becomes impossible for the pig to develop its full capacity for growth and fattening. This may be turned to advantage perhaps with young stock intended for breeding, where the aim is to secure growth combined with only a moderate degree of fattening, but with pigs that are required to grow and fatten quickly for purposes of slaughter the bulkiness factor clearly imposes a limit upon the economy of use of green fodders. As to where this limit lies a certain amount of evidence is available from recent experimental work with fresh greenstuffs in Denmark and Germany.

In the first Danish experiment the attempt was made to replace 10, 20, 30 and 40 per cent. of the concentrated food by corresponding amounts (in food units) of green food (green oats, clover-grass). The concentrated food was a mixture in equal parts of barley and maize meal, and this was supplemented by liquid separated milk. The average results obtained over a period of 7 weeks with pigs of about 55 lb. initial live weight are summarized below:—

Group	*I*	*II*	*III*	*IV*	*V*
	kg *	kg	kg.	kg	kg.
Av Daily Food Consumed					
Concentrates ..	1·38	0 90	0 70	0·52	0·33
Green Food	—	0·98	1·60	2·07	1·89
Separated Milk	2·10	1·60	1·40	1·26	0·91
Ratio, Wt Concs. Green Food	—	1 1·1	1 2·3	1 . 4·0	1 : 5·7
Av. Daily Liveweight Gain ..	0·448	0·321	0·234	0·162	0·066

* 1 kg. = 2·2 lb

It will be noted that, as the proportion of green food given increased, the average rate of growth steadily decreased, until in Group V, where the attempt was made to replace up to 40 per cent. of the concentrated food by greenstuff, little more than maintenance was secured.

This experiment is vitiated, however, by the fact that there was a considerable reduction in protein supply from group to group, ranging down from a daily average of 0.168 kg. in Group I to 0.080 kg. in Group V. Closer attention was paid to this point, therefore, in a second experiment, in which two groups receiving green lucerne at different rates were compared with a control group that did not get green food. In this instance the ratios of the actual weights of concentrated foods and of lucerne fed were 1:0.5 and 1:1, representing in terms of "food units" a replacement of about 5 and 10

per cent. respectively of the concentrates given to the control group. The average liveweight gains are given below:—

Group	*I*	*II*	*III*
Per cent. Conc. Food replaced by Lucerne ..	0	4·9	9·9
Ratio, Wt Concs Wt Greenstuff ..	—	1:0·5	1:1·1
	kg.	kg.	kg.
Av. Daily Liveweight Gain . .	0·620	0·711	0·676

It will be noted that, under these conditions of approximately equal protein supply, the highest growth rate was obtained with the lower allowance of greenstuff, but this was doubtless in part due to stimulation of appetite since this Group actually ate more concentrates than Group 1 despite its additional consumption of greenstuff. If allowance is made for this, there is little difference between the records of the three Groups. Similar results were obtained in a further comparison along the same lines in which two groups received green lucerne on the 5 per cent. scale of replacement, and two others 10 per cent., with a fifth group as control:—

Group	*I*	*II*	*III*	*IV*	*V*
Per cent. Conc. Food replaced by Lucerne .. .	0	5	10	5	10
Ratio, Wt Concs Wt Greenstuff	0	1:0·5	1:1	1:0·5	1:0·9
	kg	kg	kg	kg	kg
Av. Daily Liveweight Gain	0·570	0·603	0·570	0·650	0·641

Here again may be seen the slight superiority of the 5 per cent. over the 10 per cent. greenstuff allowance, the difference, however, not being such as to rule out the 10 per cent. rate as excessive. The whole trend of these experiments suggests that the practical limit of economic supply of greenstuff under these conditions was in the region of the replacement (on the basis of food values) of about 10 per cent. of the meals, which implies a ratio of about equal weights of greenstuffs and meals. This was finally confirmed in what may be regarded as the best experiment of the series, in which again five groups were compared under conditions of equal and adequate protein supply:—

Group	*I*	*II*	*III*	*IV*	*V*
Per cent. Conc. Food replaced by Lucerne	0	3·0	6·1	9·0	12·2
Ratio, Wt. Concs. Wt Greenstuff	—	1:0·24	1:0·53	1:0·81	1:1·1
	kg.	kg.	kg.	kg.	kg.
Av. Daily Liveweight Gain ..	0·569	0·601	0·587	0·590	0·564

It will be seen that, as measured in terms of liveweight increase, the greenstuff proved an effective substitute for the

cereal meals until the amount of greenstuff consumed began to exceed that of meal consumed.

In all these experiments, separated milk was used as the protein concentrate, and the question was left open as to whether the same results would be obtained without the separated milk, using other protein concentrates. This is perhaps even more important for British conditions, and it is useful therefore to have confirmation from recent German experiments that substantially the same results are to be expected when the milk is replaced by fish meal and similar substitutes.

In these experiments, green lucerne, red clover and sweet lupins were chaffed and mixed in different proportions with a feeding meal consisting of 50 per cent. barley, 40 per cent. dried potato flakes and 10 per cent. dried (unextracted) sugar-beet. To this mixture was then added sufficient fish meal to make the total supply of digestible protein in the day's ration of each Group up to 0.250 kg. A typical set of results is summarized below:—

Group	*I*	*II*	*III*
Ratio, Wt Concs Wt Green Food	--	1 1	1 . 2·4
	kg.	kg.	kg.
Av Daily Liveweight Gain .. .	0·560	0·500	0·361

In two other experiments the daily allowance of concentrates was fixed for the greenstuff groups at 1 kg. (= 2.2 lb.) per head and they were left to satisfy the rest of their appetite from an *ad lib.* supply of greenstuff. The results summarized below are of interest as indicating the effects on total food consumption and rate of gain.

	EXPT. 2		EXPT. 3	
	No Green-stuff	*Green-stuff*	*No Green-stuff*	*Green-stuff*
Ratio, Wt Concs * Wt Green Food eaten	--	1 3·6	—	1 2
	kg	kg	kg	kg.
Initial Liveweight per pig	41·3	41·0	21·5	21·7
Wt Concs * eaten per day .	2·85	1·0	2·14	1·0
Wt. Greenstuff eaten per day .	—	3·6	—	1·95
Av. Daily Liveweight Gain	0·655	0·374	0·527	0·383

* Excluding Fish Meal

It will be seen that with the fixed allowance of 1.0 kg. per day of concentrates the heavier pigs of Experiment 2 consumed on the average 3.6 kg. (= 7.9 lb.) of greenstuff, as compared with an additional 1.85 kg. (= 4.1 lb.) of concentrates con-

sumed by the control group. Similarly the lighter pigs of Experiment 3 consumed 1.95 kg. (= 4.3 lb.) of greenstuff, as compared with the extra 1.14 kg. (= 2.5 lb.) of meal consumed by the control group. Thus in each case the amount of greenstuff taken to satisfy the pigs was roughly double the extra amount of meal taken by the control pigs. That these quantities of greenstuff were too great to allow the full growth capacity of the pigs to be developed is shown by the slowing down of the daily liveweight gains.

From the Danish and German experiments it seems probable, therefore, that, provided care is taken to maintain an adequate protein supply, meal may be effectively replaced by greenstuff until the amount of greenstuff consumed approaches to equality with the amount of meal supplied. This makes a considerable economy of meal possible, but still leaves the need for something rather more than one-half of the normal meal requirements. The following schedule indicates roughly how, on the basis of the foregoing German data a feeding scheme for meals and greenstuff might work out as compared with normal meal feeding:—

NORMAL FEEDING *lb meal per day*	MEALS AND GREENSTUFF *lb per day*	
	Meal	*Greenstuff*
1½	1	1
3	2	2
4½	3	3
6	4	4

The effective use of greenstuff naturally implies that the pig will eat a rather greater weight of food daily than he would on meal alone.

Where fresh greenstuff is not available a substitute may be found in dried lucerne or dried grass. Experiments with dried lucerne in Denmark and with dried grass at Harper Adams have indicated that these materials can be effectively employed up to the extent of about 10-15 per cent. of the ration, a limit which is substantially in agreement with that found for the fresh greenstuffs.

THE FIGHT AGAINST POTATO DISEASE

REDCLIFFE N. SALAMAN, F.R.S.

The potato to-day is so firmly established in our economic life that it is not surprising that much of the research which has been directed to it should be inspired by economic considerations. The last thirty years in particular have been rich in such research, with results which have had important industrial effects.

The more purely scientific issues, however, have not been neglected, and much of the success in the elucidation of the mysteries of virus has been due to the blending of inspiration originated by economic need and an academic desire for knowledge. That free play should have been given to both is a tribute to the wisdom of the Ministry of Agriculture and Research Councils of this country no less than to the workers concerned.

In the beginning of this century the stimulus was derived from the occurrence and rapid spread of potato Wart Disease, which in some parts of the country threatened to inhibit further cultivation of the crop. The first reaction to this danger was the discovery of resistant sorts amongst existing varieties, followed by an outburst of potato breeding.

Contemporary with and the logical sequence to the fight against Wart Disease was the elucidation of the genetical basis of Wart Disease inheritance, as well as other important characters of the potato plant, and the recognition of synonymous varieties. The former has passed into the corpus of genetical literature and need not be further discussed here. The latter has not only afforded the breeder most valuable assistance, but has exercised, and still does, an invigorating influence on the industry as a whole. Indeed, the repercussions of this pioneer work are now being felt in other fields, especially in the cereal and horticultural trades. The Synonym Committee of the National Institute of Agricultural Botany, which began work at Ormskirk in 1917 under the late John Snell, has, during the last twenty years, weeded out the sham potato varieties, i.e., old varieties masquerading under new titles, both from the fields of England and from the seedsmen's catalogues. The extent of the evil may be gauged from the fact that in the early years of the Committee's work

the percentage of synonyms was found to be as high as 75 per cent. of the whole collection of varieties existing. To-day, largely as a consequence of this work, the grower knows exactly what he is planting and hence takes an active and critical interest in the character of varieties, especially new ones, and their adaptation to the requirements of his land and market.

More important still has been the recognition of the nature of the so-called degeneration of varieties. That potato varieties " run out " in one locality in the course of a few years whilst in others they hold their own indefinitely had been recognized for some 150 years. At times and in certain localities this degeneration has been so rapid and the areas in which it supervened so extensive that the continued cultivation of the potato has been threatened. This was notably so in the Cheshire and Lancashire districts in the latter part of the eighteenth century. Even to-day the propagation of the same variety, if raised year by year from home-grown " seed," cannot be continued for more than a few years in the southern counties without serious loss. It was only in this century that the nature of this degeneration was understood and shown to be due to infection by virus agents, the most destructive of which are conveyed by the common green-fly, *Myzus persicae*.

In the last twelve years the advance in our knowledge of plant virus diseases in general has been outstanding. Before this period, and even to-day in Russia and certain quarters in Germany, degeneration is attributed to soil conditions. Thirty years ago it was widely ascribed to "old age " and the wearing-out of a variety. Research on these and similar diseases has been carried out in Great Britain: at Cambridge, Rothamsted, and Bangor, and by the late Professor Paul Murphy in Ireland, whilst invaluable work on similar lines has been done in Holland and America. The scientific value of this work has been great indeed. Such aspects of it as the isolation of crystalline preparations of purified virus, the estimation of particle size and structure, and the discovery of acquired immunity in plants, have placed the study of plant virus in the forefront of scientific progress.

We must, however, in this article, confine ourselves to a consideration of the economic aspects illuminated by our newly-won knowledge. In this country, virus disease and common blight are responsible for most of the damage suffered by the potato crop, each costing the country on the average several

million pounds annually. It is therefore of interest to enquire in each case how far modern research has helped or promises to help in controlling these scourges.*

Virus Diseases. We know that the two most destructive virus diseases are Leaf Roll, caused by Potato Virus No. 14,† and Leaf Drop Streak, caused by Potato Virus No. 2. Both can in a suitable season so infect the growing plants in the field, even though the latter be derived from virus-free seed, that the resultant crop may be reduced to 30 or 50 per cent. of what it normally should have been and, what is worse, the tubers of such a crop, if used as seed the following year, will give rise to such poor and unthrifty plants that the resulting crop may fall to scarcely 20 per cent. of the normal. From this nexus, rich soil, good culture or heavy manuring offer no relief—the stock is ruined.

There are several other virus diseases which affect the potato adversely, but in England they play a lesser part; in Ireland and America it is otherwise, but, even so, their problem, whether it be viewed economically or from the point of view of preventive action, remains practically the same as our own.

We know further that both Leaf Roll and Leaf Drop Streak are transmitted from diseased to healthy plants by means of the green-fly *Myzus persicae,* an ubiquitous pest in all our fields.

The defence problem thus narrows itself down to this:—How can we prevent the spread of an incurable disease which is transmitted from infected foci in the field to healthy plants by a widely dispersed and rapidly multiplying insect? The attack may be approached from several angles:—

1. The removal of sources of infection as under:—
   (a) The removal of infective foci.
   (b) The destruction of carriers other than potatoes
   (c) Rogueing of the crop
2. The use of clean, i.e., virus-free, seed.
3. The control of the vector: the green-fly, *Myzus persicae,* the chief vector of potato viruses.
4. The use of seed potatoes immune to virus infection.

* The subject of Blight will be dealt with in a later article.

† The numbers given for the potato viruses are those assigned to them in Dr Kenneth Smith's *Text Book of Plant Viruses*

Let us see how far our present knowledge allows us to progress along these lines.

THE REMOVAL OF INFECTIVE FOCI. The main sources of infection are to be found in infected groundkeepers left over from previous potato crops, and in such gardens and allotments where the same crippled stocks are grown on year after year. Adequate rotation of crops and good cultivation will remove the groundkeepers; more education and a heightened garden-sense the latter.

Other foci are to be found in Solanaceous weeds, especially *S. nigrum* (Nightshade) and *S. dulcamara* (Bitter-sweet). The latter weed of the hedge may be infected with Leaf Roll; the former is not infrequently found to be infected both with Potato Virus No. 1 (" X ") and Potato Virus No. 2 (" Y ") and may in the field act as a carrier of either. The complete removal of these weeds from potato-growing areas is essential. Clean and thorough cultivation is a pre-requisite of successful potato raising.

ROGUEING OF GROWING CROPS. Rogueing is of real value if it is done betimes. It should be carried out in the latter half of May before the winged aphis has begun to migrate to any serious extent. All weakly plants, as well as those with rolled or mottled leaves, should be removed, taken out of the rows and burnt. A second rogueing in mid-June is to be recommended. If rogueing is left till later in the season its value is greatly reduced, for by July the damage is done even if the symptoms of infection have not appeared.

THE USE OF VIRUS-FREE SEED. Given good cultivation and the absence of infective foci (see above), the use of first-class virus-free seed is the keystone of successful potato culture. To-day, certified stocks of very high quality can be obtained at reasonable prices from Cumberland, Scotland and Ireland; indeed, the prices are not higher than those often demanded locally for infected uncertified stocks which are a danger both to the grower and his neighbours and which would be dear at any price. Although it is impossible to over-rate the importance of virus-free seed, it must be realized that unless the other protective measures to be mentioned are observed, the best seed in the world will degenerate and the grower's money be lost.

In this relation it should be confessed that the supply of first-class potato seed in Great Britain is totally inadequate to

satisfy national requirements. Three or four times as much as we are producing to-day would be necessary if our fields are to give the highest returns conformable with good farming and high wages. This deficiency is, in the opinion of the writer, a pregnant source of national danger, and it is to be hoped that the Potato Marketing Board will give this matter its earnest consideration.

Control of the Insect Vectors of Disease. Perhaps the main enemy of the potato-grower is the green-fly, but not all green-flies or aphides are equally guilty. Indeed, one species, viz., *Myzus persicae*, is so deeply involved in the dissemination of virus diseases not only amongst potatoes but amongst most of our garden plants and vegetables that such measures of attack as may be devised must be designed to meet the attack of this particular species. Some knowledge of the habits and life history of *Myzus persicae* is necessary if our efforts are to have any chance of success.

Myzus persicae in the wingless form is a small aphis of greyish-green colour with short cornicles or abdominal horns which are rather swollen towards their extremities; on the inner side of the base of each feeler or antenna is a small frontal knob. The skin of the body is dull olive-green colour and often peculiarly rough as if irregularly covered with a greyish-green powder. In the late season, and especially when found on turnips, the body colour may be red. The winged form is black-coloured and shiny, very slender, with delicate transparent wings.

It is in the wingless form that most of us have observed the green-fly on the under surface of the potato leaf, a point which may act as the starting point in our account of its life history. Early in the season very small pale-green *Myzus persicae* may be seen in small groups on the under-surface of the leaf; these have been born alive from the first winged migrant form; casting their skins and growing rapidly they will, when adult, produce viviparously and parthenogenetically innumerable further young. This process of multiplication goes on vigorously for 3-4 months, the aphides being only prevented from covering the entire face of the earth by their susceptibility to adverse weather conditions and the assaults of such enemies as the larvae of the ladybird and hymenopterous insects which parasitize and kill the wingless forms to a varying but occasionally severe extent.

In addition to the wingless form, varying percentages of winged types are born on the potato leaf and these, after feeding, migrate to distant potato plants, carrying virus with them if their last host was virus-infected. Meanwhile, the wingless aphides, each one a potential carrier of disease, crawl from leaf to leaf and succeed in reaching neighbouring plants when contiguous leaves form a bridge over which they can pass. In September, winged forms appear again, and as the potatoes mature they migrate to their winter quarters.

Where apricot and peach trees exist, these become their favourite winter resort, but should any turnips or other brassicae be near to the potato fields then they will invade them and carry on by wingless parthenogenetic generations throughout the winter and early spring, when once more winged forms appear.

From the brassicae the winged forms migrate to other cruciferous plants, foremost amongst which are the two commonest weeds, Shepherd's-Purse and Charlock. Here they settle and multiply till the first potatoes appear above ground. The earliest will be such groundkeepers as may have been left in the field from previous crops and it is from these that the aphides become infected. Amongst those aphides which succeed in settling in the cracks of the bark of peach trees are male forms which mate with the females, as a result of which eggs are laid from which, in spring, winged forms emerge ready to migrate to the potato field.

Certain facts about the habits of the winged forms, the knowledge of which we owe to the late W. Maldwyn Davies, have an important bearing on potato culture. The winged aphides will only take to wing under the following conditions:—

1. The temperature must be 65° F, or higher
2. The moisture of the air must not exceed 70 per cent
3. The wind must not exceed a velocity of 8 m.p h.
4. The brighter the sunlight, the more active the aphides

This brief account of the life history of the potato-growers' arch enemy allows us to appreciate four things: First, that nature has endowed the aphis with an almost fool-proof mechanism for reproduction on a colossal scale. Second, that there are moments in the life cycle of the aphis when it is subject to attack or when the environment may be so influenced as to interrupt an essential step either in development or migration. Third, that if there were no aphis there would be no degeneration of the potato crop. Fourth,

that efficient as the aphis is as a disseminator of disease, it fails in one respect: an infected mother transmits the virus neither to her viviparous offspring nor to her eggs. The young can only obtain their virus from the plants they themselves feed on and that, of course, only when those plants are already infected.

Hitherto, the only serious attempt on a large scale to protect our potato crops against degeneration by virus disease has been the production of high quality seed, a measure in itself of the highest value. So far practically nothing has been done by indirect methods. Two lines of action are open to us:—

1. To cultivate potatoes only where there are few or no aphides.
2. To attack the aphis at some vulnerable point in its career.

The first of these may be dealt with briefly. There are no places where there are no aphides, but there are plenty where they are scarce and where the migration of the winged form is impeded. Such areas are those where the air is laden with moisture and the winds are high. These two conditions are realized to varying degrees of perfection on our western coast, especially in the exposed parts of Ireland and Scotland. Such areas may not always be agriculturally suitable, but many which might be so are totally neglected. The writer has pointed out on many occasions that the Hebrides, and especially the smaller outlying islands, are ideal spots for potato raising, especially for the production of seed, for here the prevailing winds are strong off the Atlantic, laden with moisture, and the soil deep and friable.

An environmental factor which has an adverse influence on the aphis is the occurrence of a high rainfall. Heavy rain will often free the potato crop for a considerable time from aphides, and if the weather remains chill and damp they may never recover their hold on that year's crop. Still, not all the potatoes we need can be grown under such conditions. East Anglia, agriculturally so eminently suited for potato culture, is equally well equipped for the continuous propagation of the aphis.

When and how can we with advantage attack the enemy in such districts? Our opportunities are less, but not negligible. Thus, the winter-breeding sexual generation can be largely eliminated by removing all peach and apricot trees from the

neighbourhood. In Germany, the close relation between the number of such trees and the density of aphis infestation has been clearly demonstrated. If removal is unpractical, winter spraying of the trees will kill the sexual forms and eggs, and early nicotine spraying the newly-formed winged form. Absence of cruciferous weeds deprives the early spring generation of a temporary home and that of groundkeepers of the source of infection, both to be attained by the use of efficient but by no means extraordinary cultural methods.

The fact that winter cabbage and turnips afford an over-wintering home for the aphis at once prompts the suggestion that potato culture should not be carried on in near association with market-gardening.

It might well be asked whether we could not treat the fields of growing potatoes with insecticide sprays and destroy the aphides on the spot, or use deterrent dressings and impede their advent. Few trials of the kind have been conducted on any large scale and there is room for research along these lines. Such treatment would need to be repeated some half a dozen times or more in the season to catch up with the ever-growing new foliage, which might create the very real danger of mechanically accelerating the migration of winged forms and extending the areas of infection. The expense might well be prohibitive.

The Use of Seed Potatoes Immune to Virus Infection. If we were in possession of varieties which were resistant or immune to virus attack we should stand possessed of a complete defence against virus infection. We have none such. Research as to the possibility of building up such varieties by planned genetic methods is under serious consideration both here and in Russia. So far the outlook is not very hopeful. The only truly immune variety known to the writer is the American seedling 41,956, which is completely resistant to infections with any or all of the strains of the "X" virus, the cause of the common Mosaic and one of the factors in the production of Crinkle, a common disease in America, and to a lesser extent in Ireland and this country.

Failing natural immunity there is the possibility of making use of the power lately discovered to impart an acquired immunity to plants, including potatoes, against certain viruses. In the case of the common Mosaic virus and its related, but rarer severely necrotic forms, such protection is both practical

and completely efficacious. In respect to this particular virus it is a question whether it is worth while, seeing that the serious and destructive type of reaction produced by some of these strains seldom occurs in our fields. If we have learnt how easy it is to impart such an immunity to our potato stocks, we have also learnt how difficult it is to obtain vaccines which are themselves harmless. With regard to the "X" virus this has been achieved. The writer has recently attempted to produce an acquired immunity in the potato against Leaf Drop Streak, but although a certain measure of success was attained, the vaccine itself produced an undesirable reaction. A similar attempt is being made with respect to Leaf Roll, but with this it is too early to speak of results.

An allied line of defence is the creation of carrier varieties, i.e., potato varieties which display no ill effects of infection. So far we have no varieties which are not adversely affected by Leaf Drop Streak, but two varieties, viz., Ulster Monarch and Edgecote Purple, may appear almost normal when under the influence of a chronic infection. It is not improbable that further research may disclose the existence of more efficient carriers of the virus. It used to be thought that no variety could stand up against Leaf Roll, but this is no longer true: in the Swedish variety Imperia we have found a perfect carrier of the virus of Leaf Roll.

To sum up then, our defence against virus infection is to be found in:—

1. Good farming in the fullest sense of the word.
2. Choosing localities where the moisture is high, the winds frequent and of fair strength throughout the growing season; especially is this desirable for seed raising.
3. The avoidance of districts where market-gardens, cabbage crops and fruit trees are prevalent.
4. The use of clean, certified potato seed stocks.
5. Intensive research with a view to obtaining a real or acquired immunity to each virus disease, and some direct control of the aphis vector.

THE FARMS OF BUCKINGHAMSHIRE

EDGAR THOMAS, B.Litt., B.Sc.,
University of Reading

Descriptive. Buckinghamshire is a narrow county about 52 miles long and from 10 to 20 miles broad. The county is divided into two distinct regions of north and south by an escarpment of the Chiltern Hills running roughly through Pitstone, Wendover and Princes Risborough. The contrast between the two regions is dramatic even to the lay traveller who pauses to look north and south at any point on the dividing line. To the south is the hilly country of the Chilterns with its chalk and extensive woodlands, rightly famed for the charm and beauty of its scenery. To the north the flat pastures of the Vale of Aylesbury stretch as far as the eye can see, to disappear in the undulating clay plain extending to the Northamptonshire boundary.

These two regions present not only a striking physical contrast, but they also present many contrasts in their economic and agricultural characteristics. It is this contrast between north and south which gives special interest to any study of land utilization in the county, for the north still remains essentially rural and agricultural, while the south has long come under the influence of urban and industrial encroachment.

From the farming point of view the biggest difference between north and south is in the relative importance of plough land. Now the farming of Buckinghamshire is predominantly grassland farming, less than one-fifth of the total farming area being under the plough. In 1936, roughly three-fifths of all the farms of the county were all-grass farms, while four-fifths had less than a third of their acreage under the plough.* Comparing north and south, however, it was found that over three-fifths of the farms north of the Chilterns were

* A complete classification of the farms of the county on the basis of the proportion of grass to arable in 1936 is as follows:—

Proportion of Grass and Arable	*Percentage No. of Farms*
100 per cent Grass	59·1
70– 99 " "	22·2
31– 70 " Arable	14·2
71–100 " "	4·5
	100·0

all-grass farms, but more than half of the farms in the south had some arable land.

Nevertheless, in spite of these differences, the most important farming industry in both north and south of the county is the production of liquid milk for the London market. South Buckinghamshire has some advantage in proximity to this market. In the Chilterns proper, dairying features as one important enterprise in a mixed farming system, while on the narrow, fertile belt of the Thames Valley in the extreme south of the county, it has long been of first importance. The northern half of the county, and especially the Vale of Aylesbury, has long had a reputation for its dairy farming. Here the change over from farmhouse processing of butter and cheese to liquid milk selling was accomplished at an early date. At the present day the whole of north Buckinghamshire is thickly populated with dairy herds.

In addition to dairying, sheep, pigs and poultry are kept in varying numbers throughout the county, while on the Northamptonshire border in the north of the county stock-raising and cattle feeding are of some significance. In 1936 just over two-fifths of the farmers of Buckinghamshire kept sheep, but sheep were relatively much more frequent in the north than in the south. On the other hand, pigs (which were kept on about a third of the farms of the county) were relatively more frequently kept on the farms of the south. Roughly two-fifths of the farmers kept poultry, and poultry are being developed in most districts both on general farms and on specialist poultry holdings.*

Market gardening and fruit culture are also important in certain districts. In the extreme southern corner, which is wedged in between Berkshire and Middlesex, nurseries and market gardens are of considerable significance, particularly around Slough, Langley and Datchet. But here, as in the adjacent counties, urbanization and industrialization are rapidly encroaching on the available land. On the southern

* A complete classification of the farms of the county according to the type of live stock (other than horses) kept in 1936 is as follows —

Farms with	*Percentage of No of Farms*
No live stock	6·5
Cattle	74·4
Sheep	43·2
Pigs	32·3
Poultry	41·2

slopes of the Chilterns the well-known cherry orchards are found, some of them attached to farms and some conducted as distinct businesses. On the gault clay east of Aylesbury a considerable area is devoted to prune-damson growing, while west of Aylesbury, at Stone, there are several plantations of standard fruit.

Main Types of Farms. The purpose of this article is to establish the numerical importance of these various types of farming in the county. All that has been attempted is a rough and ready classification of the farms of the county according to the farmer's own description of his farming. Such a classification is obviously very arbitrary, and cannot claim any scientific precision. Provided its limitations are remembered, however, it does supply a useful indication of the relative importance of the major types of farming which exist.

The figures quoted were obtained during an economic survey of the agricultural industry in Buckinghamshire made in 1936 by the Agricultural Economics Department of Reading University.* It was then ascertained that the total number of holdings in the county which were "farmed" in the generally accepted sense was 3,480. (The total number of all holdings of over one acre in the county was 4,254, but 20.5 per cent. of these were not "farms" in the ordinary sense.) Sufficient information to justify some attempt at grouping according to farming types was obtained for 3,061 farms, i.e., for 88 per cent. of the total.

3,061 BUCKS FARMS GROUPED ACCORDING TO TYPE OF FARMING IN 1936

Type of Farm	No of Farms		Acreage	
	Total	Per Cent.	Total	Per Cent.
1. Dairy Farms	1,521	49·7	207,380	63·8
2. Cattle-raising and Feeding Farms	420	13·7	41,129	12·7
3. Poultry Farms	258	8·4	4,546	1·4
4. Pig-keeping Farms . .	127	4·2	4,791	1·5
5. Mixed or Miscellaneous Farms..	477	15·6	59,181	18·2
6 Horticultural Holdings . ..	258	8·4	7,910	2·4
TOTAL	3,061	100·0	324,937	100·0

* *The Farms and Estates of Buckinghamshire*, by Edgar Thomas and C. E. Elms. (University of Reading, Bulletin LI.)

In the accompanying Table the 3,061 farms are grouped into the following six major types: dairy farms, cattle-raising and feeding farms, poultry farms, pig-keeping farms, mixed or miscellaneous farms and horticultural holdings. The Table corroborates what has been stated above about the predominant importance of dairy farming in Buckinghamshire, and dairy farms are shown to account for nearly half of all farms and for well over three-fifths of the total farming acreage. No other type of farming in any way approaches the position held by dairying, either as regards number of farms or the farming acreage concerned.

DAIRY FARMS. The production of milk for sale was the major enterprise on all the 1,521 farms included in the first group of the Table. On many of the farms included in the "mixed" group dairying was also important, although taking a secondary place.

Nearly four-fifths of the 1,521 dairy farms were in the north of the county, where they accounted for well over half of the total number of farms. In south Buckinghamshire, on the other hand, dairy farms accounted for less than two-fifths of all holdings.

The small, all-grass dairy farm is typical of Buckinghamshire. Exactly half of the 1,521 dairy farms under discussion were under 100 acres in size, while more than half were all-grass holdings. The average size of the 830 all-grass dairy farms concerned was only 43 acres, as against 166 acres for 691 dairy farms with arable land.

The dairy farms with arable land can be divided into two groups—those with under and those with over 30 per cent. arable. The first group contained 530 farms, and on these farms the produce of the arable land was mainly, if not entirely, utilized by the dairy herds. The second group contained 161 farms, and on these the raising of arable crops for sale was a subsidiary enterprise of some significance. On 24 of the farms, orchards and market gardening were subsidiary enterprises, while on 29 farms hay-selling or agistment formed part of the farm economy.

Dairy cows were the only live stock (other than work horses) on 223 of the dairy farms: most of these were small holdings, their aggregate area being only slightly over 6,000 acres. Other classes of cattle were kept on 900 of the farms; on most of these calves were reared and weaned. The keeping of grass sheep as a subsidiary enterprise was characteristic of

many dairy farms, particularly in the north of the county, sheep being kept on 887 of the 1,521 dairy farms. Poultry were kept on 688 farms and pigs on 586 farms, both poultry and pigs being more or less important sidelines.

CATTLE-RAISING AND FEEDING FARMS. Of the 420 farms included in this class, 317 were in the north and 103 in the south of the county. Actually this class consists of the following four sub-classes:—

253 stock-raising and grazing farms
94 bullock-feeding farms
52 calf-rearing farms
21 farms producing down-calvers

On 117 farms cattle were the only type of live stock kept. (In 84 of these the occupiers were not full-time farmers, and most of the farms were small.) On only 21 of the farms were dairy cows kept for milk production, but sheep were kept on 156 farms, pigs on 95 farms and poultry on 78 farms. Of the 94 bullock-feeding farms, 80 were in the north of the county in what is really the southern extremity of the midland grazing pastures.

POULTRY FARMS. Poultry-keeping in Buckinghamshire, as in the rest of the country, is still mainly associated with general farms rather than with specialist poultry holdings.

There were 258 farms (134 in the north and 124 in the south) having poultry-keeping as their chief business, and most of these were more or less specialist poultry holdings. On 176 of these farms no other live stock was kept, 44 farms kept pigs, 37 kept cattle and 11 kept sheep. In a few instances goats, bees and/or market-gardening were combined with poultry-keeping. Most of the poultry farms concentrated on the production of eggs and chickens. The once celebrated industry of duck-rearing in the Aylesbury district failed to survive the setback received during the war years. Ducks, however, were still important in the Bledlow district. Several farms on the Chilterns specialized in the production of game-bird eggs. Turkey rearing was found as a secondary enterprise more particularly on farms in the north of the county.

Most of the poultry farms were smallholdings, only 18 of the 258 being over 50 acres in size. Of the remainder 134 were under 5 acres, 76 from 5 to 20 acres and 30 from 20 to 50 acres in size.

PIG-KEEPING FARMS. Pig-keeping, like poultry, is also associated with general farming rather than with specialist

holdings. Thus, although pigs were kept by 988 farmers in the county, only 127 kept pigs as their chief enterprise.

Of the 127 specialist pig holdings, 59 were in the north and 68 in the south of the county. In the north 24 of the pig farms were in the Newport Pagnell district, and in the south 36 were in the neighbourhood of Eton and Slough.

Most of the 127 farms were small holdings, only 17 being over 100 acres in size. No other live stock was kept on 44 of the farms, 65 kept poultry, 29 kept cattle and 14 kept sheep.

MIXED OR MISCELLANEOUS FARMS. The farms in this class are of a very heterogeneous type. Really it is a class composed of those farms which could not rightly have been included in any of the other five classes. The fact that it includes 477 farms must be taken as evidence of the difficulty (if not indeed impossibility) of making a comprehensive classification. Nevertheless, it is possible roughly to distinguish the class as consisting of the following sub-groups.

Firstly, comes a group of 121 farms (90 in the north and 31 in the south) on which the chief concern was sheep husbandry. When it is stated that some sheep were kept on nearly 1,300 farms in the county it will be realized that these 121 " sheep " farms contributed only a very small proportion of the total sheep population of the county: The most striking feature regarding sheep in Buckinghamshire is the large number of small flocks of grass sheep found on general farms, especially in the north of the county. Hurdle sheep are few and far between, and even the arable farmers of the south have abandoned them.

Secondly, comes a group of 84 farms on which the growing of arable crops for sale was the chief concern. On all 84 farms, however, live stock formed appreciable secondary enterprises. Most of the 84 farms were in the districts bordering on the Chiltern Hills, but with a small, scattered group around Newport Pagnell in the north of the county. All 84 farms were comparatively large, the average size being 160 acres.

Thirdly, comes a group of 105 farms which can rightly be described as mixed farms. On all 105 farms the growing of arable crops for sale vied in importance with the keeping of live stock. Most of these farms were also in the Chiltern country. The average size of the group was 120 acres.

Fourthly, comes a group of 77 farms covering nearly 5,000 acres on which the chief business was the breeding, training or grazing of blood-stock, hunters, ponies and shire horses.

These farms were scattered all over the county, 55 being in the north and 22 in the south. The majority were not concerned with other farming activities. The group included several blood-stock studs of national repute.

Fifthly, comes a group of 53 farms covering nearly 10,500 acres which were occupied by farmer-dealers. Forty of these were in the north of the county in the stock-raising areas where the farmer-dealer plays an important rôle.

Lastly, comes a small, scattered group of 37 "farms," whereon the chief business was hay-selling. The total acreage of this group was only 1,000 acres, and only six of the occupiers were full-time farmers.

HORTICULTURAL HOLDINGS. It may be merely a coincidence that the number of horticultural holdings in the county should be shown to be the same as the number of poultry holdings. Of the 258 horticultural holdings, 108 were in the north and 150 in the south of the county. The total area concerned was 7,910 acres—123 holdings were under 5 acres in size, 89 were from 5 to 20 acres, 19 from 20 to 50 acres and 27 over 50 acres.

The 108 holdings in the north of the county consisted of 81 orchards, 22 market gardens and 5 nurseries. Most of the 81 orchards were small, prune-plum orchards lying in a belt of country starting from the extreme east corner of Weston Turville and extending north-west across the Chilterns. The chief centre is around Edlesborough. The 22 market-gardens in the north were situated in the vicinity of the various small townships which they served.

The 150 holdings in the south of the county comprised 63 market gardens, 50 orchards and 37 nurseries and florists' establishments. The chief centre of the horticultural industry in Buckinghamshire is in the south-west corner of the county. Here a combination of suitable soils and proximity to the London market has resulted in the development of one of the most important market-gardening areas in the country. The 63 market-garden holdings in the south occupied a total of 5,250 acres. Eleven of these holdings were over 200 acres in extent and were almost entirely devoted to market-gardening, so that the big scale of the undertakings can be easily appreciated. The 50 orchards in the south were mainly the celebrated cherry orchards of the Chiltern Hills. Among the 37 nurserymen were many famous seed, bulb and rose growers.

Conclusion. It may be desirable to indicate very briefly the purpose of such a statistical classification of farms as has been attempted here. *Agricultural Statistics,* published annually by the Ministry of Agriculture, provides a fairly comprehensive picture of the structure and distribution of the farming industry in every county in England and Wales. This annual report shows, *inter alia,* the acreage under each kind of crop and the numbers of each class of live stock in each county. But it does not attempt to show the distribution of the farms of the country by farming types. For instance, *Part 1* of *Agricultural Statistics* gives the total acreage of arable land or the total number of dairy cows in every county, but does not give the *number of farms* with arable land or the *number of farms* keeping dairy cows. It is this further information which must be forthcoming before any attempt can be made to classify the farms of the country by farming types and thereby show the distribution of the industry *by types of farms.* Recent departures in agricultural policies have increased the need for this kind of information and classification. For in its absence it is not possible to know what *numbers of farmers* in different parts of the country are affected by the variety of State assistance at present enjoyed by the industry. The need for such knowledge cannot seriously be contested.

THE FARM HEDGE AND ITS TREATMENT

J. S. Featherstone,
Instructor on Manual Processes, Nottinghamshire

Although this branch of farm husbandry is unproductive, it is false economy to neglect it. Often it does not receive the attention it deserves as, owing to the lack of knowledge and skill, it becomes a more expensive item on the farm than need be. How often one sees a hedge being treated in an indifferent manner without any forethought, with the result that it is rendered useless for a long period despite considerable expenditure.

It is often said than an overgrown, neglected hedge does not justify the necessary expenditure to put it in good condition, but, as there is no fence so serviceable as the well-kept thorn hedge, it is well worth considering some method of repair that will result in a lasting service, even if comparatively costly.

The splitting up of the larger estates and, consequently, the passing of the estate woodman has in many instances increased the cost of material such as stakes, binders and fencing, as these must now be found by the farmer himself. So it is that neglected hedges often lead to either a dilapidated farm or considerable expense to the farmer.

As many farmers now own their own farms it is very essential that they should acquire a general knowledge of the treatment of the hedgerow and so arrange for its maintenance by sound economical treatment.

During the last few years various County Councils have appointed instructors to demonstrate and teach methods of hedge cutting. The Hunt, too, has taken considerable interest in organizing Hedge Cutting Competitions. There is, however, still room for instruction in general management throughout the country. There is still a scarcity of skilled hedgers in many parts of the country, especially in districts where the thorn does not thrive well, for it is in such districts where the most skill is required. It is, however, possible to find men skilled in the actual work, but it is a far more difficult

matter to find such men capable of transferring their knowledge to others. This lack of teachers is probably one of the reasons why so few of the younger generation take up this work.

The object of this article is not to try to teach the actual work of hedge cutting but to give an idea of general maintenance that will result in the most economic treatment.* It is important that those responsible for the management of the labour should understand the necessary treatment for the improvement of hedges to suit varying conditions and, at the same time, keep in mind the farmer's desire for a low expenditure.

Arrangements can then be made to give each individual hedge such treatment as will suit surrounding conditions, improve and render the hedge serviceable for a prolonged period at an economic cost.

An interested and observant person can gain much information by noting the growth of a newly-cut hedge. The local Hedge Cutting Competition is also a source whence one may obtain much valuable information by observation of different men displaying their skill and by noting the after effects which the various lengths invariably display, such as the progress of growth, cleanliness of cut, type of hedge built to suit the surrounding conditions and damage done by lack of protection

The work must be planned to suit the condition of the hedge. Those no longer stockproof may be cut without delay; others in better condition may remain to serve as shade or shelters, or, in some cases, the hedge may merely require trimming to improve its appearance and that of the farm.

Distinct types of work are practised in different parts of the country and are often followed blindly without due regard to the surrounding conditions. Generally the best types of work are practised in grazing districts, on heavy, retentive soils where the thorn thrives. In such districts the skilled hedger is more in evidence. This is probably so because the work is regarded as being of importance and also other types of work are scarcer. Farmers in these districts encourage hedgers as they realize the importance of good hedges to prevent cattle from straying. Good grazing is assisted by keeping stock in their allotted areas.

* A fairly good description of the actual work may be obtained by reference to this JOURNAL, Vol. XXXVI, September, October and November, 1929. By following the detailed description given one can, with actual practice, obtain excellent results.

The more neglected and inferior hedges are usually found in the poorer, wet or sandy soils where rabbits abound and also in outlying districts in industrial areas. No doubt this is accounted for by the scarcity of good hedgers as other work is available both during the summer and winter.

Renovating Hedges by Cutting and Laying or Plashing. One may well be discouraged by many old, overgrown hedges that are no longer stockproof, knowing well that to put them in good condition is sure to be costly. The only successful method of renovating such hedges is by " cutting and laying," sometimes known as " plashing " or " pleaching." It is important to obtain the best skilled labour and to see that the work is carried out to the best advantage so as to spread the cost of renovating over a prolonged period (15-20 years in many cases). If this work is carried out by an inferior workman in a careless manner it will only result in a hedge which will prove less stockproof than previously and will need fencing to be of any use at all. Added to this the farmer has wasted money on the work and is still faced with the additional cost of protecting the hedge while it is outgrowing the maltreatment.

Hedges may be plashed at any time during the winter between October and April, or even later providing the bark at the back of the layer is firm and remains in position to carry the flow of sap and support the layer. The hedge must be tall enough to fill in gaps when " layed " and should have sufficient material available to make a strong, stockproof barrier against every kind of stock.

The gappy, weak bottom hedge that has been trimmed and is no longer stockproof must be allowed to grow up until tall enough to make a hedge of the required height and strength. Under certain conditions it may be advisable to " split it " or " side up " to encourage new, vigorous growth, but this method can only be adopted where surrounding conditions and future requirements allow, e.g., arable-land hedges or those between arable land and grass or roadside and grass. In giving this treatment the cutting is done on the arable or roadside only, leaving sufficient brush on the grass side to serve as a barrier. Straight, vigorous growths proceed from below the cuts and by admitting light and air the vitality of the hedge is increased. The " mat " caused by continuous " brushing " is cut through and so lightens the work of cutting and laying.

Care must be taken not to cut away material which will assist in making the hedge stockproof.

Important Features of Good Hedge Cutting. It may be advisable to point out the essentials of good hedging. Firstly, decide the type of finished article that will be most suitable for the surrounding conditions and the purpose which the hedge is intended to serve. Between the grazing fields build a hedge of at least 4 ft. 6 in. high. The layers should be turned over at the base, staked firmly in position with brush on either side to serve as protection, especially if there is no ditch. In the event of one grass field being mown, it is advisable to work in the mowing field, placing the majority of the brush to the grazing side where it will be needed most as protection. The meadow side will become established before being stocked and will require little protection. In the event of a ditch being present on one side of the hedge, it is advisable to work in the ditch, laying the layers from the ditch and using the brush as protection on the grazing side. After cleaning out the watercourse, thorns may be put neatly on the banks of the ditch as protection to new growth proceeding from the "stools." The thorns will not interfere with the watercourse and will prevent cattle from trampling in the ditch. Between arable land, or roadside and grass land, the whole of the brush may be thrown off the stools and placed on the grass, using an abundance of brush and strong layers to make an effective barrier. No protection is necessary for these conditions.

An arable land hedge should not be more than 3 ft. 6 in. high and should be built to form the shape of a capital A, or wedge shape, that can be economically trimmed annually or, better still, twice annually.

When "laying" a hedge on a steep hill it is advisable to lay the layers uphill, commencing at the top of the hill and working downwards. This precaution is not necessary where the gradient is only slight.

There are times when it is difficult to observe the rules of the direction to lay. If a hedge has been layed in the opposite direction to that advised above, it may be necessary to lay in the same direction again in order to utilize new growths growing from the old layers. These may have to be lowered first to serve one's purpose. Where possible, however, it is advisable to adhere to the rules first mentioned.

Layers should be layed off from every " stool " in the base of the hedge as this assists in keeping the stools alive. If the growths are cut off at ground level and not utilized as " layers " the stools will die. An illustration of this can often be found at the beginning of a hedge where a hedger has cut off growths in order to make a gap large enough to commence work. Only a very small " layer " is needed to keep the stool alive and it is obvious that it is very important as live " stools " encourage new growths from the base of the hedge. After the " layers " have been turned over it is important to cut off the " lips," in other words, pare the stools near ground level to enable new growths to start from dormant buds at the base of the hedge.

It is also advisable after layering, staking and binding to soil the roots. This may be done by cleaning out the ditch or by digging and spreading soil around the roots. Care must be taken not to soil above the stools as this will retard growth to some extent.

A well layed hedge should be thoroughly clean, free from chips, leaves, decayed wood, elders and other weeds. It is also very important to rid the surrounding land of rabbits as these cause considerable damage to newly layed hedges.

Renovating Old Hedges. It is a fairly simple matter to cut and lay an even thorn hedge where there is an abundance of long, straight material growing from the base. It is, however, considerably more difficult to renovate the old overgrown, gappy hedge which has been severely ill-treated in the past by an inferior workman. A hedge of this type may have only a few useful growths at intervals or may have large stools from which layers have been layed knee high, resulting in new growths some distance from the ground. Portions of the hedge may be ruined by the presence of elders or other quick-growing, leafy plants or else by growths that are almost completely barked by rabbits.

This type of hedge requires special treatment to renovate and considerable skill is necessary. It is most essential to provide some protection until it has grown into an effective barrier.

The most difficult feature in the treatment of such a hedge is the lowering of the ill-treated " stools " and layers in order to make the hedge stockproof. It is this part of the work that is not generally understood by the average workman. It

is a common idea that it is impossible to lower these old " stools " that appear to be so very brittle. It may, however, be accomplished by splitting them down on a side leg or by root plashing. The former method is the most suitable to adopt because better growth is obtained from the remaining stool. One should remember that all growths, young or old, are more pliable near the root than at any other part of the stem. It is, therefore, quite possible to lower these " stools " and " layers " despite the previous hedger's failure to do so.

The procedure is, firstly, to select a side leg or a smooth, flat portion on which to turn the layer. Then proceed to cut and pleach down to the selected portion by making a long, gradual cut, thus weakening the stem at the ground level but, at the same time, ensuring sufficient material to withstand the pressure of lowering the growth into position. The stool is then pared off just above ground level to allow for new growth. It is a mistake to pare off the stool at exactly ground level as growing buds are thus destroyed.

To root plash a stem it is necessary to remove the soil and expose the roots. Then, select one or two suitable side roots, sever the remainder and lower the layer into position. It will, of course, be understood that roots do not make as much new growth as is produced by stool plashing and for this reason should only be practised where other methods would be unsuitable. Extra growth may be obtained on the layer by cutting deeply into it near the base.

Long gaps in the hedgerow, where thorns have died, can be filled by causing the formation of new " stools " by burying a portion of the layer. The growth is pleached by the most suitable method and a trench or hole dug. A few cuts are then made on the portion that will lie in the trench and it is then pegged down or held in position with soil. If well rammed it will generally take root and so form stools in the gap if some of the branches are cut off above ground level. Stems which have been badly damaged by rabbits may be similarly treated, or alternatively, by root plashing.

After-treatment of Newly Plashed Hedges. The treatment of a hedge after cutting is ruled to a certain extent by the purpose it is intended to serve and the general method of farming the surrounding land.

In grazing districts, strong stockproof hedges are essential.

They should form effective barriers against all kinds of stock, both large and small. If the work of "plashing" has been done in a satisfactory manner, the hedge will require little further treatment for a period of anything up to fifteen years with the exception of protecting it for the first two years of growth. During this time, besides acting as a barrier, the hedge will also serve the very useful purpose of providing shade or shelter for stock. In time the hedge will need plashing again, but this is not necessary as long as the base remains in good condition. It is not advisable to cut the whole length of the hedges on grazing land at the same time. Portions should be left to serve as shade or shelter while those cut grow up.

The after-treatment of hedges situated between arable land and roadside, and between roadside and grass land differs from the former method as it is important to keep them within bounds by trimming. If they are to remain effective barriers that can be trimmed at an economical cost, this trimming requires more skill than is usually understood. For two years they should be protected on the grass side and allowed to grow up from the stools. Then, once or twice a year trim the arable side or roadside of the hedge only, taking care to cut back new growths to the stools or the level of the layers and forming one side of a wedge shape. A few strokes to level the top is all that is wise. It may appear rather drastic to cut back useful, two-year-old growths in this manner, but it will be found that a firmer, stronger hedge is the result. The shortened stems will put out more new growths and form a sound foundation for future trimming.

When cutting off these two-year-old growths it is important to cut in the direction in which the stems grow with an upward stroke of the slasher. By doing so clear cuts will be made.

After this treatment the hedges can be trimmed annually. When cutting one-year-old growths the direction of the stroke may be changed from an upward to a downward stroke. This is a quicker, easier and more effective stroke that will encourage more bottom growth. After the arable or roadside of the hedge has been trimmed for about four years and has strengthened and formed a strong mat, the opposite side may be shaped to form a wedge-shaped hedge.

The hedge situated on arable land should be trimmed, after two years' growth, to a wedge-shaped hedge not more than 3 ft. 6 in. high. This treatment may be continued once

or twice a year as long as the base remains in a sound, stock-proof condition. The advantage of the wedge-shaped hedge lies in the fact that when trimming, only one stroke on either side is necessary. The stems are cut with a slanting stroke, thus causing an abundance of growth at various heights up the side of the hedge. It also enables the work to be done rapidly and the base of the hedge is kept in condition for a longer period.

" HEDGE SCOTCHING " or " BUCK HEADING " is another method of after-treatment that, in certain circumstances, can be carried out with success. It is a means of lowering hedges, but can only be practised where the base of the hedge is stockproof and stools are evenly spaced. An ideal hedge for such treatment is one that has made about eight years growth after plashing. It must have sound layers in position and sufficient material to form a stockproof hedge *after* the sides and top have been removed. After " scotching " the hedge may be allowed to grow again or it may be trimmed annually. Once again, the wedge-shaped hedge is desirable when scotching a hedge, and as the stems are some years old it is important to cut with an upward stroke of the slasher in order to leave a clear cut that will heal quickly and make new growths. It is important to ensure that the stems are severed at various heights up either side of the hedge to allow of an abundance of new growth. A narrow top and wider base will form a very suitable hedge that will make good progress and be easily trimmed if desired. Whatever work is being carried out on a hedge, it is always desirable to leave it free from decayed wood, leaves, weeds, etc.

Hedge Plants. In conclusion, a few remarks may be made on the different varieties of hedge plants found in the hedge-row. The hawthorn is most favoured for hedging purposes as, if correctly treated, it forms the most effective barrier. It thrives best on heavy soils but will grow on almost any well-drained soil. It will withstand considerable ill-treatment, but grows with vigour after clean cutting, laying and cleaning.*

Many distinct varieties of varying habits are found in the hedgerow. There seems little knowledge available to indicate whether soil condition or the variety of thorn is responsible for the more vigorous types found on the clays. Farmers

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* Much valuable information may be found in this JOURNAL, Vol. XLIII, August, 1936, in an article " The Hawthorn Plant."

often consider the land responsible, while hedgers sometimes claim that their particular style of work is the cause of the excellent growth. The writer, however, is led to believe that the variety of thorn is the most important factor.

When planting new, quick hedges, it is an advantage to select a quick-growing variety, which is not only more vigorous, but much more satisfactory for the hedger to work. The more vigorous types of thorn appear to have larger leaves and fewer spines and make considerably more growth from stools after cutting. In the actual work of cutting it will be found that they split and cut with ease, while the slower-growing varieties are dry, brittle and more difficult to manipulate. The old native species has a broad leaf and a habit of throwing out many growths at the base, often eight or more from a single stool and has rather slender stems which are inclined to entangle. Hedges of elm, privet, ash, holly, blackthorn, maple, myrobella plum and hazel are common, but all inferior to the hawthorn.

MANURING AND CROP DISEASE

F. HANLEY, M.A.,
School of Agriculture, Cambridge

It is not unnatural to assume that a vigorous individual, whether animal or plant, is likely to be less susceptible to the attack of disease organisms than a less vigorous individual. Though such assumption is not always true, e.g., the downy mildew diseases are said to thrive best on vigorous host plants, it is probably true of a great many diseases. Alternatively, even if actual plant vigour is not always an effective safeguard, it must be remembered that manuring, in its widest sense, affects not only the supply of available plant food but also other soil conditions that are known to influence the spread and intensity of fungoid diseases. For instance, soil reaction or lime status has a marked effect on the incidence of several diseases as will be shown later. Instances can also be given in which apparent excess or deficiency of one or other of the common elements of plant food have had a very definite effect on the incidence of some particular disease. Again, the fact that addition of organic matter to the soil may so stimulate the general activity of micro-organisms that they decompose fungal material in the soil, raises the question of the possible rôle of farmyard manure in the control and spread of disease. Most people look upon farmyard manure, lime and artificial fertilizers as something that will increase the supply of available plant food in the soil and, by so doing, encourage the growth of bigger crops. But these materials may also exert a direct influence on the incidence and control of disease, and the following paragraphs are intended to illustrate the importance of this aspect of manuring.

Farmyard Manure. The effect of the presence of one micro-organism on the incidence or activities of others is now receiving a good deal of attention from research workers. Definite instances are known in which the presence of one disease in a plant may render it susceptible to another disease to which it is normally resistant. On the other hand, certain non-parasitic soil micro-organisms are now known to exert a definite antagonistic influence on some of the diseases usually

carried over from crop to crop in the soil. Farmyard manure and green manuring, by stimulating the multiplication of soil micro-organisms, may reduce or control certain disease organisms.

An instance of this sort of effect is to be found in one of the measures suggested for the control of Take-all disease of wheat. The increase in Take-all or Whiteheads in recent years has given rise to much concern in some of the cereal-growing districts of the east and south of England, though the disease has probably been present in this country as long as wheat has been grown. The recent increase is suggested by Garrett in the *Journal of the Royal Agricultural Society* for 1937 as likely to be attributable to changes in farming methods, particularly in regard to the frequency of cereals in the rotation and the reduction of live stock on many farms. The blackening of the base of the stem, caused by Take-all should not be confused with the somewhat similar blackening caused by another fungus disease that is sometimes associated with lodging, namely, *Cercosporella*. The Take-all fungus does not cause lodging. Careful examination of affected plants will show that the Take-all disease causes blackening of the roots as well as the base of the stem, whereas *Cercosporella* does not affect the normal white colour of a healthy root. The fungus appears to be chiefly soil-borne, being carried over from crop to crop either on diseased stubble or on alternative host plants, such as rye grass, and common weeds, such as couch grass and slender foxtail or black grass. Barley is also liable to suffer severely from this disease, but oats appear to be a fairly safe crop, in England at any rate.

The important point to bear in mind is that the fate of the fungus in the soil, and therefore its ability to attack future crops, depends very largely upon soil conditions. It seems to survive longer in light soils than in heavy ones, and it is favoured by alkaline soil conditions, e.g., by overliming. From the manuring standpoint, plants growing in soil of low fertility suffer more severely than plants growing on land in good heart, for a plentiful supply of plant food enables an attacked plant to put out new roots in place of those destroyed by the fungus. Dung is said to be particularly beneficial not only by producing a strong-growing plant but also by stimulating soil micro-organisms that are thought to be capable of checking the spread of the fungus on the roots of affected plants and accelerating its decomposition and disappearance

when infected stubble is ploughed in. Green manuring is also said to hasten the disappearance of this fungus from the soil, probably by favouring the activity and spread of other soil organisms antagonistic to the Take-all fungus, in the same way as dung.

In other circumstances, on the other hand, farmyard manure may actually favour the incidence and spread of disease and it is necessary to bear this in mind when utilizing produce from disease-infected crops. For instance, Club-Root or Finger-and-Toe can be spread by farmyard manure, for if roots infected with this disease are eaten by stock, it is said that the disease can be returned to the land in the manure from such stock, either by roots escaping consumption and being trodden into the litter or by direct passage of spores of the disease through the alimentary tract of the animal and their eventual excretion in the dung.

Farmers frequently look upon farmyard manure as a potential means of spreading weed seeds and are often particular to guard against this contingency. From the above examples it will be seen that it is just as essential to regard farmyard manure as an important potential agent in the control and spread of plant diseases: control, by encouraging the multiplication of soil organisms antagonistic to the fungal mycelium of certain diseases such as Take-all; and spread, by the actual transport of infective material.

Lime. The reaction of the soil, i.e., its lime status, is a determining factor in the incidence of several diseases. On the one hand, lime deficiency or soil acidity may be an important factor in favouring the spread of disease, e.g., Finger-and-Toe in turnips, swedes and other cruciferous crops. On the other hand, a high lime content, leading to alkaline conditions, may be an equally potent factor in the spread of disease, as in the case of Take-all referred to above. A farmer growing a variety of crops, therefore, may seem to be faced with a difficult problem in trying to suit them all in this matter of the lime content of his soil. For instance, Common Scab of potatoes is a disease which is encouraged by alkaline soil conditions and the fear of inducing this trouble has led many potato growers farming land deficient in lime to refrain from liming their land. This omission has often had serious repercussions on other crops in the rotation and has tended to encourage the spread of Finger-and-Toe in

some market-garden districts where potatoes and cruciferous crops are grown extensively.

A good general rule in these and, indeed, in most circumstances is to keep the soil as near neutral as possible by the use of occasional small dressings of lime. In other words, avoid the necessity for heavy dressings of lime; be careful not to give more lime than is necessary to bring the soil back approximately to neutral; and in the particular case mentioned above, apply the lime as long as possible before the next potato crop is to be planted, i.e., for the crop immediately following a potato crop if possible.

In addition to the diseases caused by definite organisms mentioned above, certain physiological troubles may arise from excessive soil alkalinity. For instance, many of the so-called minor element deficiencies are frequently associated with such conditions, e.g., boron and manganese deficiencies, but it is not proposed to discuss these so-called deficiency troubles in this article.

Artificial Fertilizers. The effect of individual elements of plant food, such as nitrogen, phosphorus and potassium on the incidence of disease is a somewhat complex problem, and it has yet to be established how plant nutrient supply affects disease resistance. For instance, it is not certain whether effects of this kind are due directly to actual abundance or scarcity of the element concerned or to the change in the proportion of the various elements relative to one another. It is often stated that excess of nitrogen predisposes a plant to attack by disease. But is this due to the increased amount of vegetative growth, combined with slower maturation, exposing a larger surface area to attack for a longer period of time or to internal changes within the plant rendering it more susceptible to disease? The effect of excess nitrogen is sometimes explained by saying that it produces a " soft " type of growth, more susceptible to disease than hard, firm growth. But " soft " growth is not always more susceptible to disease than hard growth, for Bewley has shown that Verticillium Wilt of tomatoes, for instance, is most destructive to hard, underfed plants.

The general tendency to-day is to emphasize the importance of balanced manuring and the supply of the various plant foods in the proportions best suited to steady growth. It is probably a good working rule to regard excess of readily assimilable

nitrogen as likely to lead to increased susceptibility to the attacks of fungus pests. But, on the other hand, nitrogen is of overwhelming importance in the matter of crop yield, and in these days of cheap artificial fertilizers it behoves the grower to give as much as the crop can utilize without suffering reduction in quality or disease resistance. The optimum amount of nitrogen to apply varies with crop, season and soil conditions, and as it is rarely possible to make an exact forecast at the time when the fertilizer treatment must be decided, any measure that will provide a safeguard against the possible harmful effects of a bad forecast is obviously worth consideration. In this connexion potash and phosphate can be useful, for lack of available phosphate and potash usually induces a decline in resistance to disease.

Potash seems to be a particularly important factor in maintaining resistance to a number of diseases and several well-known examples of its effects in this connexion are frequently encountered in farm practice. Field beans well supplied with potash, are more resistant to Chocolate Spot disease. At Rothamsted, Leaf Spot is more prevalent on mangolds growing on plots receiving no potash than on neighbouring plots treated with potash. Again, liberal dressings of potash fertilizer are the best treatment for Streak disease in tomatoes.

It is often suggested that the balance of nitrogen and potassium is an important factor in disease control and it is true that potassium does seem to counteract, in some measure, the ill effects of excess nitrogen.

Phosphate is, of course, likely to be particularly important in connexion with diseases which attack the root system, for most crop plants are capable of putting out a large number of roots, and since phosphate generally encourages root development it may help a plant to overcome loss of roots arising from disease.

An instance of this is to be seen in the controlling effect of superphosphate on the Take-all disease of wheat in Australia. The explanation of this result presumably lies in the fact that since one of the chief effects of Take-all is to kill off the roots, any circumstance which is likely to encourage the formation of new roots should help the plant to resist the disease. This, of course, is an additional reason for ensuring an adequate supply of phosphate for crops susceptible to this type of disease.

An interesting instance of manurial treatment affecting the

incidence of disease was reported by T. Wallace in an account of a manurial trial with black currants at the Long Ashton Research Station, published in the *Journal of Pomology* for June, 1938. The importance of potash in the manuring of fruit plantations has been amply shown at Long Ashton, two striking examples being its effect on Leaf Scorch and on the quality of dessert apples. With blackcurrants, potash was again successful in controlling Leaf Scorch, but the conditions in the trial were such that susceptibility to another trouble, the Leaf Spot disease, was increased by either nitrogen or phosphate deficiency, but decreased by potash deficiency. In other words, the deficiency that favoured Leaf Scorch reduced susceptibility to the Leaf Spot disease. This result provides an admirable conclusion to this article, for it makes clear the fact that the selection of fertilizer treatment is inevitably a matter for compromise. It must be such as to work with reasonable satisfaction over a considerable range of soil and climatic conditions and, whilst designed to produce vigorous growth it must help to protect that growth from pest attack as far as possible, either by making soil conditions favourable to the plant and unfavourable to the growth and spread of the disease, as in the case of soil-borne diseases, or by increasing the resistance of the plant to the disease. This can be summed up best by advising the adoption of balanced manuring, adequate supplies of lime to maintain the soil in an approximately neutral condition and regular applications of dung or other organic matter to stimulate the activity of soil organisms.

VITAMIN SUPPLEMENTS IN PRACTICAL PIG FEEDING

A. S. Foot

AND

S. K. Kon,

National Institute for Research in Dairying
University of Reading

Introduction. The word " vitamins " may not be of much significance to some farmers in connexion with pig-feeding. During recent years, however, the adoption of intensive methods of pig-rearing and feeding has brought to many the realization that these factors may play a very important part in practice, for, under modern conditions, the pig may have no opportunity of correcting by " rooting " any defects which may occur in its ration.

Farmers have sometimes been forced to resort to the use of potent sources of various vitamins without a clear picture of which factors were likely to be deficient in their meal mixtures or which particular factors the supplements supplied.

As far as can be ascertained from experimental evidence, the farmer's attention should be directed mainly to the two vitamins A and D. The pig apparently requires no vitamin C, and any ration, unless very abnormal in constitution, would supply all the factors of the vitamin B complex.

Vitamin D is required in particular where the diet is low in its content of either calcium or phosphorus. If these mineral constituents are adequate, only very little vitamin D is needed. Vitamin A, on the other hand, must always be made available to the pig and it now seems probable that it is a deficiency of this vitamin that the farmer should make particular efforts to avoid.

In passing, it may be mentioned that animals can satisfy their need for vitamin A either from plant or animal sources. In the first case the active substance is in the form of the deeply orange-coloured *carotene*. In the second, the almost colourless vitamin A is found. We know now that carotene is active because it can be converted in the animal body, most probably in the liver, into vitamin A.

The Shinfield Experiments. The results[1, 2]* of a number of pig-feeding experiments carried out at the National Institute for Research in Dairying have shed new light on certain aspects of the pig's requirement for vitamin A, and it is our object here to discuss this work briefly and mention the practical implications.

Most of the experiments were carried out with a ration consisting of:—

Barley meal	50 parts
Middlings	35 ,,
Soya-bean meal	8 ,,
Meat meal	5 ,,
Ground limestone	$1\frac{3}{4}$,,
Salt	$\frac{1}{4}$,,

A person used to the compounding of pig rations might at first sight pass such a ration as sound. The protein and mineral contents are catered for and no food is included that could be considered unusual for pigs. With the exception that our pigs were always kept indoors, our methods of rearing and feeding were normal farm practice. The pigs were all home-bred pedigree Large Whites from healthy stock. The sows during pregnancy were kept in paddocks in woods and given proprietary pig cubes. The pigs were farrowed in the piggery and kept indoors throughout their life. The youngsters were offered their rations dry behind creeps during suckling and thereafter fed the same ration in the form of a slop, about 3 lb. of water being allowed for each pound of meal.

Nevertheless, these conditions had disastrous results, for we consistently failed to produce marketable bacon pigs on the ration. Many would grow well until the later stage of the fattening period, when the appetite often decreased and some scouring appeared. Growth ceased or became irregular. Pigs would stumble as if unable to see and, in the more advanced cases, convulsive fits and nervous collapse occurred. In some the gait became rambling and awkward. Others became thin, leggy and rough in the coat. A drooping ear and staring eyes were characteristic.

The association of this condition with vitamin A deficiency was proved beyond all reasonable doubt by preventive or curative treatment with substances containing this vitamin. If vitamin A were included in the diet from the start the pigs grew to bacon weight without a hitch. If the animal on the

* For references, see p 919.

diet alone were not too badly affected, a rapid cure could be brought about by feeding a substance containing vitamin A.

In two experiments we found that if the pigs were given a massive dose of vitamin A at weaning they stored enough of it to last them up to bacon weight even when none was later included in the diet.

Vitamin A in Practical Pig-feeding. From the experiments mentioned it is clear that some of the meal mixtures recommended and used in this country are deficient in vitamin A. The fact that troubles similar to those which we encountered are not widespread may be partly due to the common practice of allowing pigs access to green food at some stage during their life. Of the foods commonly fed to pigs, yellow maize alone contains an appreciable quantity of carotene (cryptoxanthine). There are, however, several practical ways in which the farmer can supplement his pig rations with vitamin A. Such supplements include cod-liver oil, halibut-liver oil or vitamin A concentrates, dried grass, dried lucerne, dried whole milk, etc.

We have discussed the use of some of these in a separate publication[1] in which, also, a full description of the earlier experiments dealing with the vitamin A and B requirements of pigs is given and the requirements of the pig for vitamin C and D are discussed in detail. Here we should like to deal mainly with our experiments on the value of cod-liver oil as a supplement for pigs fed indoors.

PIG-FEEDING EXPERIMENTS WITH COD-LIVER OIL. Cod-liver oil from reputable sources contains not only vitamin A but is a rich source of vitamin D and may possibly exert also other effects due to its character as oil. These properties have to be taken into consideration when assessing the results of the present experiments.

The experiments with cod-liver oil were carried out with the primary object of finding out the most satisfactory and economic proportion of this oil which should be included in a meal mixture very similar in composition to that used in the experiments mentioned above. At the same time we wished to find out if this oil, when included up to 2 per cent. of the diet, justified its use at this level or had any deleterious effect on the health of the pig or on the quality of the carcass. We used a commercial cod-liver oil guaranteed to be pure and to contain 1,000 International Units of vitamin A and 100 International Units of vitamin D per gramme.

Twelve litters of pigs were used. Six received the control ration alone, two received ½ per cent. cod-liver oil, two received 1 per cent. and two received 2 per cent. mixed with the control ration.

The pigs were limited to their respective rations throughout their life and their dams received the same rations for about two weeks before the pigs were born. The pigs were from six dams, of which each produced two litters. The first litter from each dam was fattened in summer and the second in winter. Both litters from each sow received the same ration.

The control ration, which differed from our previous diet only in the substitution of weatings for middlings and in a slightly different proportion of limestone and salt, was made up as follows:—

Barley meal	50 parts
Weatings	35 ,,
Extracted soya-bean meal	8 ,,
Meat meal	5 ,,
Ground limestone	1½ ,,
Salt	½ ,,

The pigs were fed *ad lib.* with their respective rations behind creeps during the suckling period. Throughout fattening they were rationed according to live weight. The quantity of meal fed was calculated each week from standards falling 10 per cent. below those suggested by Wood (Ministry of Agriculture Bulletin 48) for dry matter requirement. On reaching 6 lb. meal per pig daily no further increase was made in the food allowance for any pen. In the later stages of fattening of some of the control pens the appetite fell below the standards used. In these instances the pigs were fed according to appetite.

The performance and disposal of the pigs are summarized in Table 1.

Comparing the six litters on the control ration with the six receiving the various levels of cod-liver oil, it will be seen that 60 pigs were born alive in each group. Deaths during suckling amounted to 19 and 16 respectively. These were largely due to crushing by the sow and to weakness of the newly born pigs in one control and one cod-liver oil litter. During the few weeks following weaning, the losses among the control pigs amounted to 7 and among the cod-liver oil pigs to 2. These differences in favour of the pigs receiving cod-liver oil are perhaps of doubtful significance, but during fat-

TABLE I.—PERFORMANCE OF PIGS RECEIVING THE CONTROL RATION ALONE AND OF PIGS RECEIVING ½ PER CENT., 1 PER CENT. AND 2 PER CENT COD-LIVER OIL IN ADDITION TO THE CONTROL RATION.

Diet.	Number of Litters	Total Number Born Alive	Deaths			Number Reaching Bacon Weight	Number Sold for Small Pork or Changed to Different Diet	Average Rate of Live-weight Gain (lb. per Pig daily)			
			During Suckling	Shortly after Weaning	During Fattening			Birth to 50 lb	50–100 lb	100–150 lb.	150–190 lb.
Control Ration alone	6	60	19	7	7	3	24	0·43	0·85	0·79	0·58
½ per cent Cod-oil	2	14	2	0	0	12	0	0·56	0·93	1·27	1·38
1 per cent. Cod-liver oil ..	2	21	7	0	0	13	1	0·59	0·99	1·23	1·42
2 per cent Cod-liver oil ..	2	25	7	2	0	13	3	0·46	1·08	1·30	1·46
All Cod-liver Oil Pigs	6	60	16	2	0	38	4	0·53	1·01	1·27	1·42

tening all the pigs receiving cod-liver oil made good progress and no losses were recorded. On the other hand, 7 control pigs died during this period. The further performance of the remaining pigs is even more striking, since of the 60 control pigs born, only 3 reached bacon weight without a change in diet, as compared with 38 in the cod-liver oil litters.

Similar marked differences are observed when the rates of growth are compared. For the live-weight intervals shown in Table I the cod-liver oil pigs, irrespective of the percentage given, made live-weight gains ranging from about 0.5 lb. per pig daily up to 50 lb. live weight to about 1.4 lb. per pig daily when approaching bacon weight. The control pigs started growing at about the same rate but soon lagged behind, and after reaching 100 lb. live weight, the few pigs remaining on the control ration, instead of increasing their rate of gain, grew more and more slowly, until 11 surviving pigs at 150 lb. were growing at considerably less than half the rate of the cod-liver oil pigs.

Almost every pig which lived long enough on the control ration alone showed one or more of the symptoms mentioned earlier in this paper. Studies of the liver reserves of vitamin A in pigs from the different groups corroborated our conclusion that these symptoms were associated with a deficiency of vitamin A.

Eleven of the control pigs showing more pronounced symptoms were given 1 or 2 per cent. of cod-liver oil in addition to the control ration and in all instances this brought about a prompt recovery. Figs. 1 and 2 show photographs of a pig before and after receiving cod-liver oil.

We also found that the 2 per cent. level did not affect the health of the pigs. In the opinion of the bacon curer it had no detrimental effect on the quality of the carcasses.

The rations used by us were also deficient in the antirachitic vitamin D, but it is doubtful whether in this experiment vitamin D was of much practical importance. In this, as in our previous work, the animals on the control ration did not show obvious signs of rickets, most probably because they received adequate amounts of calcium and phosphorus. It should be pointed out, however, that the bones of pigs receiving the cod-liver oil contained slightly more ash than the bones of the control pigs. The vitamin D present in the cod-liver oil exerted therefore, in these circumstances, some beneficial effect.

It is possible that cod-liver oil, in addition to supplying

FIG. 1. Pig 635 when 242 days old and after receiving the control ration alone since it began to eat. The pig had an abnormal gait for some weeks and when the photograph was taken it was unable to use its hind legs. Vision was poor and growth below normal.

An addition of 2 per cent. cod liver oil was made to the diet at this stage.

FIG. 2. Pig 635 when 290 days old and after receiving an addition of 2 per cent. cod liver oil to the control ration for 48 days. Growth had returned to normal and vision was much improved. Control of limbs had returned although the gait remained awkward.

vitamin A and vitamin D, served other useful purposes, but any value in this respect was apparently masked by the pronounced effect of the oil as a source of vitamin A.

General Conclusions. Of the vitamins at present recognized, the two that are most likely to be of economic importance to the pig feeder are vitamin A and vitamin D. The latter may assume considerable importance where the mineral content of a meal mixture is inadequate. The vitamin A supply apparently always requires careful consideration since meal mixtures similar to those used in our experiments might be expected to lead to the same troubles as we experienced if the pigs were never allowed out and were confined exclusively to such a diet.

It is still uncertain to what extent green food and yellow maize may be counted on as a supply of carotene from which the pig can manufacture its own vitamin A, and if there is any doubt it is obviously important to provide other sources. Cod-liver oil, from a reputable firm, has been shown to be of great value in this respect. This also supplies vitamin D. Our work has shown that ½ per cent of such cod-liver oil in the diet throughout life is adequate when it is used primarily as a source of vitamin A. Since, however, the pig can store vitamin A in the liver over long periods, the feeding of 1 per cent. in the ration during the first 3 or 4 months after birth and none thereafter may be the more practical method.

For those who are interested in economical pig feeding, a knowledge of the vitamin requirements of the pig is of considerable importance. On the one hand, the financial loss resulting from a deficient ration, such as that described above, is great. On the other hand, money can easily be wasted in buying superfluous and expensive supplements.

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LETTUCE GROWING IN CALIFORNIA

W. F. Darke, B.Sc., Ph.D., B.Litt.

During the last twenty years, lettuce has become one of the most important vegetable crops in the United States. So much thought and ingenuity have been applied to this vegetable that lettuce production is almost a science in itself, and the American public are ensured of first-class but cheap salad base all the year round. California and Arizona, many hundreds of miles from the main markets, are the chief homes of this expanding industry and certain recent developments in these States may be of interest to English farmers and horticulturalists. The following notes chiefly concern, not the small areas tended by the Japanese or rented by the Portuguese elements of the population, but the larger specialized areas, varying from 150 acres upwards in the famous Salinas-Watsonville sections to the vast tracts of the Imperial Valley, California, or the Salt River Valley, Arizona, which are devoted entirely to lettuce and worked on factory lines.

Although much of California lies in the same latitude as North Africa and has a fairly reliable climate, it must not be thought that it is an agricultural Elysium, for the farmer depends almost entirely on irrigation and has his share of worry through occasional seasonal frosts and natural bacterial enemies. Nevertheless, the present organization of the lettuce industry is almost perfect.

Cultivation practices are the first things to notice. The type of lettuce most favoured is the Iceberg, which was developed mainly by the efforts of J. C. Jagger, the senior pathologist of the U.S. Department of Agriculture in 1916, in order to combat the Brown Blight and Mildew which were seriously handicapping growers.

The lettuce is no longer grown on the flat, but in raised beds to ensure better aeration and more sunlight, and this method is responsible for the ribbons of green and gold which the traveller sees radiating from the skyline in Southern California. Special machinery makes these beds. A new kind of tractor-drawn power equipment ploughs, harrows and

levels the soil in one operation. Heavy cultivators and double disc harrows provide the tilth, while another machine prepares the beds about 42 in. apart. More tractor-drawn equipment plants several rows in one operation, allowing two rows of plants, complete with an irrigation furrow, on each shoulder of the bed. When the seedlings are about two inches high, machinery takes a rest, for great gangs of coloured workmen, chiefly Philippinos and Mexicans, thin them to distances of about 14 in. Regular irrigation and occasional top-dressings bring the lettuce to maturity in about 100 days, with variations due to the climate and seeds. In one district at least it may be noted that a large area is dusted with fertilizer, broadcast not from the land but from the air. An ex-war-time pilot is reputed to fertilize at a cost of only 75 cents (3*s.*) an acre. With an airplane flying 50 ft. from the ground and loaded with 400 lb. of fertilizers at a time, it is possible to cover fairly evenly a strip 33 ft. wide.

The really ingenious methods, however, start with the gathering operations. At this stage the "farm-factory" is really seen at work. Only rarely appear the field crates so familiar on an English farm. A tractor or a lorry with a special drive, holding five steel-framed baskets 8 ft. long, 4 ft. wide, 3 ft. deep, and straddling two rows of lettuce, moves slowly through the field with the workers on either side keeping pace while steadily pulling the plants. When full, the baskets are taken to the packing house, where the wheels or castors enable them to be placed quickly at the trimming stations, where the roots and outside leaves are removed.

The modern packing-shed is a well-planned integrated unit. At a new Salinas depôt, for example, ice is manufactured and conveyed mechanically to three nearby packing-sheds, owned by various distributors. From the hoisted field baskets, lettuce travels to the trimmers who work along the side of a travelling packing table, which spouts jets of iced water continuously. By the time the packer receives them, the lettuce are washed, cooled, and sorted into grades. The standardization of packing is complete when crates containing four, five, or six dozen heads are wrapped in paper, iced, and trade-marked. These are wheeled out to a platform and loaded straight into specially ventilated railway trucks fitted with ice-bunkers which are refilled at special points on the long journey to the middle-Western and Eastern markets. A still further economic development in cutting the costs of the

packing processes is being made with the introduction of the mobile ice-making unit. This will dispense with the fixed ice-making plant, which is only used in certain seasons, for this modern machine can be mounted either on a lorry or a railway truck and can be moved to any locality for the provision of " snow-ice " or ice briquettes at a very low cost.

It can be plainly seen that the whole system of planting, picking, and packing offers many savings in time and money, while the lettuce is marketed in better condition owing to less handling and more careful treatment. The reasons for these remarkable developments are undoubtedly the large scale of business, the close co-operation of the distributors, and the distance from markets which compel careful preparation of products.

On the distribution side, there is also mass handling and selling. Whole railway cargoes are bought by brokers to be broken into smaller parcels for shopkeepers, and in this work the grades and trade-marks have an obvious value. Recently the big multiple stores have entered the vegetable field and make mass purchases either through a buying organization or by special representatives travelling through the growing areas. With a small margin of profit and a big turnover, these stores ensure constant sales of lettuce, and have undoubtedly been a great help in the disposal of large crops which would not have been sold otherwise.

It must be admitted that this large-scale industry has acute selling problems. Lettuce is always being produced in some part of California and other States in the Union, and early maturity, excessive acreages and heavy yields have contributed a train of discouraging handicaps in recent years. On the other hand, small fortunes have been made by men who have made a special study of the industry. Both the Federal Government and the individual States have been obliged to legislate to enforce marketing agreements between the growers, and all the usual expedients of market control have been tried—reduced loadings, the elimination of lower grades, the ploughing up of surplus acreages and the like. In spite of these temporary drawbacks it is the efficient men who are able to continue in the business, for besides the question of cost cutting, their methods produce the fresh, attractive and well-packed article which has an immediate appeal to the buying public.

LAND DRAINAGE WORKS CARRIED OUT BY THE RIVER CROSSENS CATCHMENT AND INTERNAL DRAINAGE BOARDS

A. E. Jackson, M.Inst.C.E.,

Engineer to the Catchment and Drainage Boards

It will be noticed from the following statistics that though the River Crossens Catchment Area is small, its rateable value is comparatively high, due to the inclusion of the greater part of the County Borough of Southport in the Area. 91½ per cent. of the rateable value is in Southport.

Another feature is the length of main rivers and main watercourses maintained by the two Boards in proportion to their areas.

Co-ordination in the work of the two Boards is maintained by the fact that many of the members of the Catchment Board are members of the Drainage Board and also that there is one Engineer and one staff of workmen (for maintenance work) for the two Boards.

Catchment Board

Area:

Pumped Area .	8,450 acres
Gravitation Area ..	29,456 „
Total ..	37,906 „

Rateable Value:

Lancashire County Council (31,446 acres)	£87,152
County Borough of Southport (6,460 acres)	£935,288
	£1,022,440

Total expenditure year ending March 31, 1938 £4,223

This amount was obtained by precepts, as follows

River Crossens Drainage Board	£1,894
Lancashire County Council	198
Southport Corporation .	2,131
	£4,223

Main Rivers ..	39½ miles
Length Embanked ..	21 „

Internal Drainage Board.
(Included in Catchment Area.)

Area

Pumped Area ..	8,450 acres
Gravitation Area	9,589 „
Total ..	18,039 „

Rateable Value:

Total £37,821

Last Rate levied 3s. in £

(Owner's Rate 2s.)

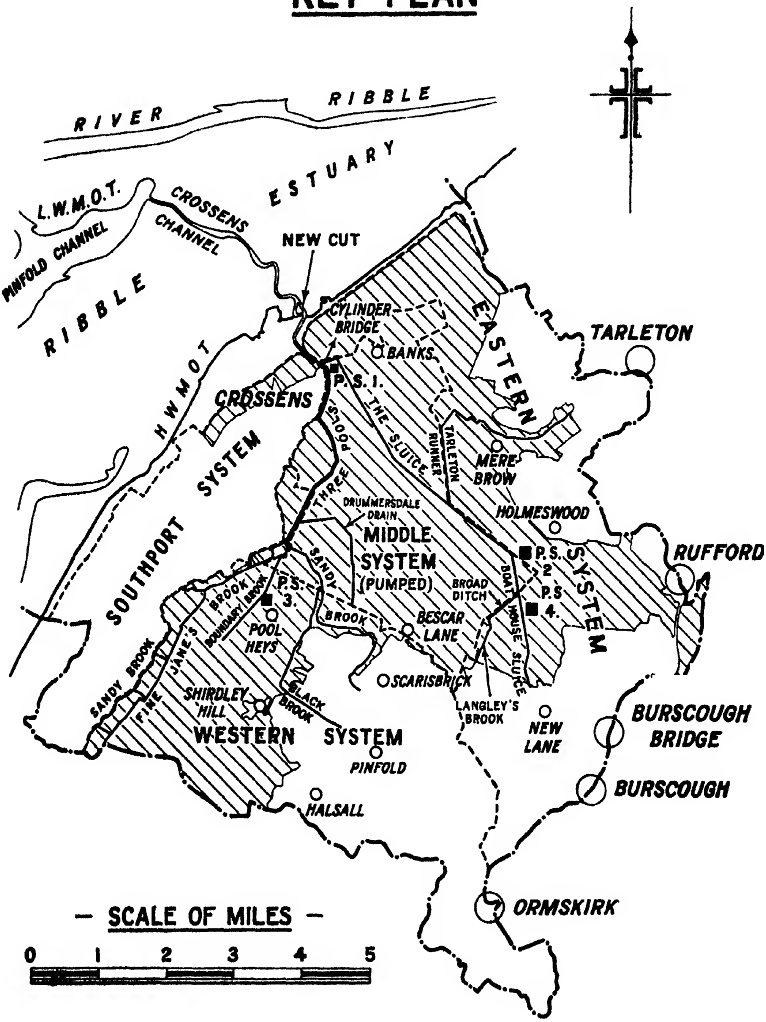
(Occupier's Rate 1s.)

Total expenditure year ending March 31, 1938	£8,433
	£8,433
Less grants of £1,502 each from the Lancashire County Council and the Southport Corporation ..	3,004
	£5,428

Main Watercourses .. (Maintained by Board)	88 miles
Sea Embankments .. (Maintained by Board)	5 „

CROSSENS CATCHMENT AREA

— KEY PLAN —



CATCHMENT AREA BOUNDARY SHOWN THUS

DRAINAGE SYSTEM " " "

" DISTRICT " "

MAIN RIVER " "

Physical Features. The Catchment Area (see Plan on p. 924) is situated on the estuary of the Ribble. The greater part is low-lying, the minimum level is 3.00 O.D. and about one-third is below the level of High Water Mark of Spring Tides, viz., 13.63 O.D. The level of the pumped area usually varies from 3.00 O.D. to 10.00 O.D., and the lowland area drained by gravitation usually varies from 9.00 O.D. to 13.00 O.D. The northerly portion of the Area is protected from the sea by an embankment and the southerly portion by natural sand hills.

The subsoil of the lowland Area is generally of peat of varying thickness overlying a compact grey silt. There are small areas of Shirdley Hill sand and boulder clay and a strip of alluvial deposit adjacent to the Ribble estuary. The subsoil of the portion of Southport in the Area is almost entirely drift sand.

Although the Catchment Area is to a large extent agricultural it contains the greater part of the County Borough of Southport, part of Ormskirk Urban District, and about a dozen villages.

Until some 240 years ago the Catchment Area drained into a lake called Martin Mere, about 6 square miles in extent, which occupied a part of the area marked Middle System on the map. Up to that time Martin Mere overflowed in an easterly direction to the River Douglas, but was then artificially drained by the Sluice in the opposite direction to the Ribble estuary.

The sea channel (Crossens Channel) into which the waters of the Catchment Area now discharge, pursues a tortuous course of 4½ miles through the marshes and sands of the estuary before it reaches permanent deep water in the Pinfold Channel.

The drainage difficulties are those usual in an area of this type, viz., a sea outlet flowing through an accreting foreshore with a tendency for the channel to silt up and an inland area of peat with a tendency to subside the more it is drained.

History. As mentioned above, Martin Mere was drained to the Ribble estuary in 1696 by the construction of a portion of a drain known as the Sluice (see Plan) with flood gates at the outlet. By 1760 the flood gates had been washed away and rebuilt, but got so choked with sand and mud that the Mere almost reverted to its original condition. In 1783 the

Sluice was improved and extended, but again deteriorated and the land was periodically inundated. In 1845-50 the system of drainage practically as it now exists was carried out and is as follows:—

The Eastern System, drained by gravitation by the high level embanked "Sluice" and its tributaries into the sea channel known as the Crossens Channel.

The Middle System, being the original site of the Mere and consequently the lowest, drained by the Back Drain (not shown on the plan but running through the middle of the System). The water from this drain is pumped at its outlet into the Crossens Channel.

The Western System, until recently drained by gravitation by three high-level embanked drains and their tributaries into the Crossens Channel These three drains (called the Three Pools), have now been combined into one by the Catchment Board

The Southport System A large proportion of the storm water from the Southport sewerage system is overflowed directly into the sea, but the storm and surface water from part of the Borough is discharged into Fine Janes Brook, one of the main rivers of the Catchment Board. The effluent and storm water from the Southport sewage works is discharged direct into the Crossens Channel.

By 1930, the main watercourses of the gravitational systems and the Crossens Channel had again become seriously diminished in capacity, with the result that very extensive flooding took place in wet weather. The peat lands in the Pumped Area had subsided and the existing pumps were obsolete and inadequate to deal with the water getting to them.

It will be observed that practically the whole of the inland watercourses which are now main rivers of the Catchment Board are artificial drains constructed at various periods during the last 240 years. These rivers, together with the larger drains, act as outfall sewers for the villages and Urban Districts in the Area, they also take the road drainage, and but for the operation of the two Boards some 15,000 acres would revert to a condition of mere and morass.

Improvement Works. The River Crossens Catchment Board was constituted by an Order made by the Minister of Agriculture and Fisheries under the Land Drainage Act, 1930, dated December 5, 1930, and the Drainage Board by an Order dated January 31, 1933. Surveys and sections of all the main rivers and levels of the lowland area were commenced immediately in order that an improvement scheme could be prepared.

From these particulars it was found that the rivers had

become so deteriorated that they would only discharge at the rate of from a quarter to a half of the full flood flow without causing flooding of the adjacent land, and that any scheme of improvement involved the dredging out of all the non-tidal rivers so as to make these capable of taking a run-off calculated at the rate of 0.32 in. of rainfall per 24 hours from the agricultural area and at the rate of 2 in. per 24 hours over the impermeable area from the portion of Southport draining to them. The average annual rainfall in the Southport district is 33.3 in., the rainfall (in.) during the last 8 years being:—

1930 ...	39.57	1934 ...	30.70
1931 ...	38.56	1935 .	34.11
1932	33.57	1936 .	33.89
1933	23.71	1937 .	25.00

Three alternative methods were considered for dealing with the flow from the rivers into the Crossens Channel:—

- (a) Dredging the Channel so as to make it capable of taking the flow from the inland rivers and relying on subsequent dredging to keep it open
- (b) Leaving the Channel in its existing condition and pumping the whole of the waters from the inland main rivers into it
- (c) As (b) but pumping during the tide lock only

The Pumping Schemes (b) and (c) were found to be economically undesirable as the annual cost was estimated to be three times that of the dredging scheme (a). Further, there was the likelihood of subsidence occurring in the gravitational peat areas if "pumping" was adopted, and in any event the Channel should be kept open for the reception of the waters that flow directly into it.

It was therefore decided to proceed with the dredging of the internal main rivers and the Channel at a total cost of £45,000, but to limit the period of the loan to 15 years, so that if at the end of that period the bed of the Channel continued to rise, notwithstanding the annual dredging, and pumping was found necessary, the finances of the Board would be free for that purpose and a limited pumping scheme could be proceeded with. Moreover the proposed dredging scheme was necessary even if pumping should be adopted in the future.

In 1933, sanction was given to the raising of a loan of £12,720 for dredging the tidal Channel and in 1934 sanction to a loan of £32,280 for dredging the non-tidal main rivers, together with a new cut 800 ft. in length required to straighten

out a short length of the new tidal Channel. The Ministry gave a grant of 15 per cent. towards the annual loan charges on the actual cost of the works included in the second loan.

Dredging of the Crossens Channel. The calculations showed that it was only necessary to dredge this Channel to the end of the outmarsh, i.e., for a length of 7,650 ft., and that seaward of this the Channel widened out in the sand so considerably as to give a sufficient hydraulic gradient from the tidal gates to take the flood waters from the inland area. The existing channel had so diminished through slips and accretion (see Fig. 2) that it was necessary in parts to increase its capacity by 400 per cent., while the bed level was lowered an average of 2 ft. 6 in.

The following particulars of the work may be of interest:—

New Bed Level	0·93 O.D. to — 0·20 O.D
Bed Gradient	1 in 6,000.
Bank or Outmarsh Level	12·50 O.D (average)
H.W.O.S.T.	13·63 O.D
Max. tide 1934 (Admiralty Tables)	17·33 O.D.
New Width of Channel at Bank Level	75 ft. (normal)
Side Slopes (cut in mud and sand)	2 to 1

Two dragline dredgers were employed on this work, one working from each bank, each with a special ramp 4 ft. 10 in. high, on to which they could travel if caught by the tide. The material excavated was subsequently spread with scrapers. The work was commenced in June, 1933, and completed in September, 1934, with the exception of the New Cut, which was done at a later date. Little difficulty was experienced in the work as it was wholly within the grassed area of the foreshore. The subsequent maintenance has up to the present been simple and inexpensive. It was found necessary at certain points where erosion was taking place to protect the foot of the bank by pit props 5 in. diameter and 8 ft. long and spaced 12 in. centres, and also to support some of the walls and banks in the upper portion of the Channel with sheet steel piling. These piles were driven by a steam hammer and the draglines, and the pit props by the draglines or a power hammer, as was most convenient.

A short length of new channel called the New Cut was carried out in 1938 so as to do away with three sharp-angled turns in the existing channel which prevented the free discharge of the water and caused trouble through erosion and the forma-

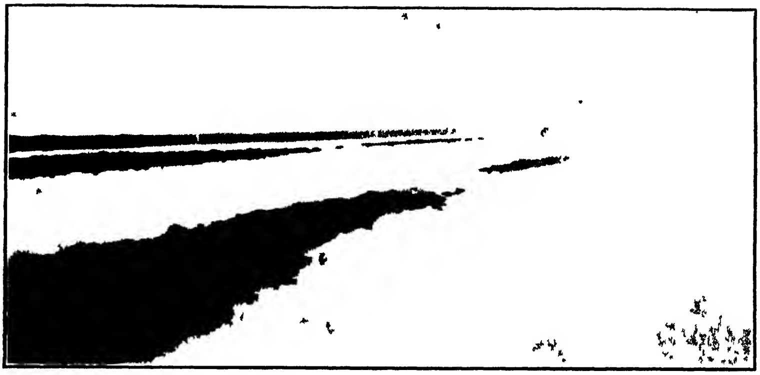


FIG. 1.—Typical Flooding of Land prior to improvement work

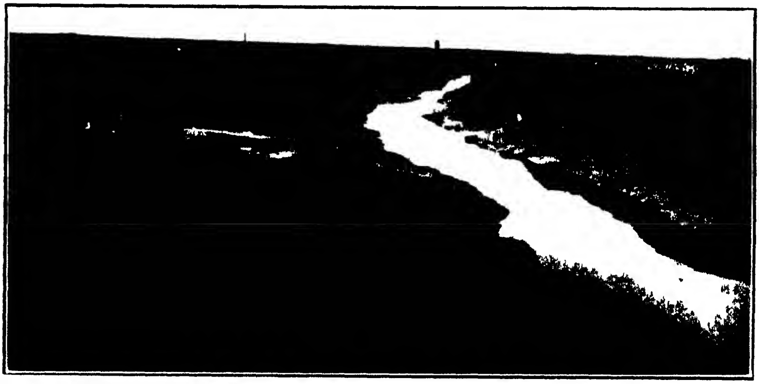


FIG. 2. Crossens Channel before dredging

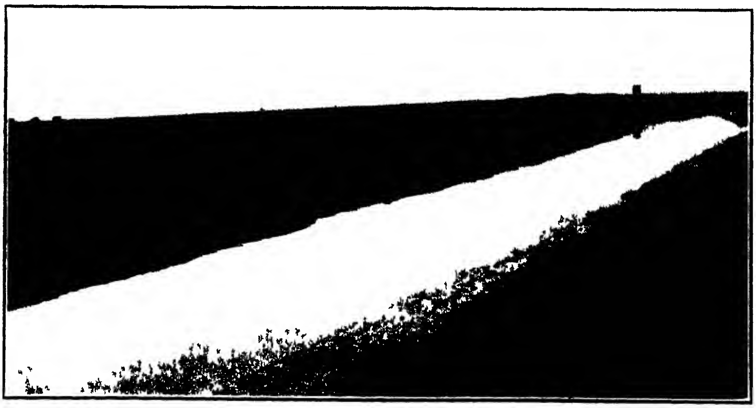


FIG. 3. Crossens Channel after dredging

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FIG. 4.—Three Pools prior to improvement

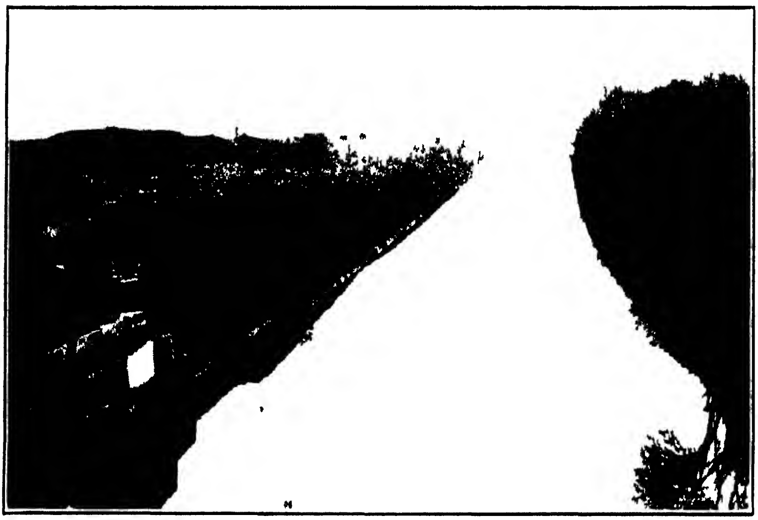

FIG. 5.—Three Pools after improvement

tion of banks in the channel. The New Cut is 800 ft. long, 14 ft. deep, 75 ft. wide at the top, and 25 ft. wide at the bottom.

The amount of material excavated by the two dragline dredgers from the New Cut was approximately 20,000 cu. yds., which was placed on the banks and afterwards spread.

In addition to improving the flow of water, the New Cut is an aid to navigation in the channel.

Dredging Internal Main Rivers. The tidal gates controlling the outlet of the non-tidal main rivers into the sea channel close for a period of 3½ hours each tide at H.W.O.S.T. The maximum level in flood conditions to which the water could be allowed to rise at the gates when open and closed without danger of flooding the lowland area having been determined, the bed levels and cross sectional areas of the various sections of the rivers were designed accordingly. The total area contributing to each main river, along with the sub-areas contributing at different points on each river, were computed and the corresponding run-off at each point obtained, from which the necessary capacity at each point was arrived at. Generally it was found necessary to enlarge the inland rivers to from two to three times their old capacity.

Chezy's formula was used in calculating the discharging capacities, the value of constant C being taken as 71.1.

The bed level of the improved rivers was fixed by the invert at the tidal gates and in fixing the bed gradients for the various rivers it was necessary as far as possible to conform to the original bed levels in order not to undermine bridge foundations or flood banks. In considering the water gradient in each of the rivers when running under maximum conditions it was necessary to arrange the new cross sections so as to give a reasonable hydraulic gradient and at the same time keep the water level sufficiently low to allow of safe impounding during tide lock.

The gradients in an area of this character are necessarily low, the bed gradients being usually about 1 in 6,000 and the water gradients during tide lock 1 in 12,000 to 1 in 16,000 and upwards, in fact in some sections the rivers may be considered as reservoirs.

The numerous artificial watercourses termed main rivers in this area are necessarily small, the two largest having maximum water widths of 45 ft. and 50 ft. respectively and the smallest a maximum width of 13 ft.

The dredging of these rivers was done efficiently by the same two draglines which had operated in the Crossens Channel. The material excavated was usually peat and grey silt which was subsequently spread. In one section a soft grey rock was met which was successfully dealt with by the draglines. The side slopes were cut to a batter of 1¼ to 1.

Here again, little difficulty was experienced, except in the number of bridges of various kinds which had to be enlarged or improved, fourteen of these being dealt with. In addition, ten new bridges are being constructed across the rivers by the County Council in connexion with their road improvement schemes.

Land Purchase and Compensation. Land to the value of £785 has been purchased in connexion with these improvement works, of which £400 was paid for the acquisition of the centre banks necessary to make the Three Pools into one waterway. The balance of the purchase money was expended on the acquisition of land for permanent sites for the deposit of spoil. The amount of compensation paid to occupiers of land for damage to crops, etc., has amounted to about £180.

Pumping Stations. When the Drainage Board took over their duties in 1933, it was found necessary to replace or reconstruct the plant in three out of the four pumping stations, as the existing plant was inadequate.

Crossens Pumping Station. (Marked P.S.1. on Plan). This is the main pumping station and deals with the drainage of 7,000 acres. When the Board commenced operations the pumping plant consisted of two suction gas engines and pumps capable of dealing with 22,000 gal. per minute against the maximum head, and steam-driven pumps capable of dealing with 11,000 gal. per minute. In 1934 the Board obtained the sanction of the Ministry to borrow £8,000 for the purpose of replacing the steam-driven pumps with three diesel engines and pumps capable of dealing with 33,000 gal. per minute. The suction gas pumps were retained as a stand-by, so giving a total pumping capacity of 55,000 gal. per minute against maximum head, and 70,000 gal. per minute against minimum head. The delivery mains were improved and the pumps arranged to draw from a level of 1 ft. 9 in. lower than the old plant.

Storage tanks for diesel oil having a capacity of 3,000 gal. were installed together with a stream line filter for the lubricating oil and water cooling tower.

Two small subsidiary pumping stations were also improved, the suction gas plant at P.S.2. dealing with 1,050 acres being reconditioned and a new diesel driven pump installed at pumping station marked P.S.4. to deal with 373 acres.

Results of Improvement Works. The Catchment Board scheme is expected to be completed in the first half of next year at a cost of some 20 per cent. less than the estimate. The results of the works so far executed are fully realizing anticipations, the flood waters carried by the main rivers being much more rapidly discharged to the sea. The danger of flooding has been greatly diminished and large areas have been brought back into cultivation. Many farms which were previously in hand are now let and the amount of unused land has been reduced to a minimum.

It is now necessary to maintain as far as possible the existing equilibrium between the levels of the sea outfall channel and the inland areas by preserving the existing depth and capacity of the outfall channel and by avoiding the subsidence of the land in the lower parts of the gravitational system of the Catchment Area, also to maintain by dredging the improved capacity of the main rivers.

TWO NEW WINTER WASHES FOR FRUIT TREES

G. L. Hey, M.A.

Advisory Entomologist, Murphy Chemical Company, Ltd.

Prior to the introduction of tar-oil winter washes into this country, soon after the Great War, the only materials available to the fruit grower for winter washing were lime sulphur, caustic soda, lime, cresylic acid and paraffin. Tar-oil washes were a great advance on these. They had, however, certain disadvantages, as they did not control all pests overwintering on fruit trees. Petroleum emulsions were therefore introduced for application after tar oil washes. The next stage was the combination of the tar and petroleum oils into a single spray, to avoid double application. Washes of this type have found general favour, but still possess certain disadvantages—they must be used on dormant trees only and, because of their early application, the control of certain pests is necessarily limited.

New toxic materials have therefore been investigated in order to produce a wash which, with one application, will control all common pests overwintering on fruit trees and which can be applied much later than tar-petroleum washes. It is recognized that for such pests as Apple Capsid and Red Spider, the eggs become more susceptible to the action of the ovicides the nearer they are to the time of hatching. Certain of these new materials showed such promise in the laboratory, that field trials were instituted. Washes containing the substances described in this article are now available in commerce.

The results summarized in this paper, obtained during 1937 and 1938, have been derived not only from definitely planned, large-scale experiments in which the wash was applied by the writer himself (Centres 1, 2, 8*b*), but also from orchards in which the wash was applied by the grower under strictly commercial conditions (Centres 3-8*a*).

In these experiments a wide range of washes was tried, but it is the purpose of this article to confine itself, in the main, to the results obtained by the use of two materials only. These were a synthetic organic thiocyanate, β-butoxy-β^1-thiocyanodiethylether and 3:5-dinitro-ortho-cresol. The thiocyanate was incorporated in petroleum oil, to give a miscible type wash, which is referred to hereafter as FL. The

constants of the oil fell within the limits generally accepted as suitable for winter washes (viscosity 125-500 seconds, Red. 1/70°F.; not more than 10 per cent. distilling below 315°C., 50 per cent. below 350°C., 80 per cent. below 380°C.).

The thiocyanate-oil wash, FL, mixed easily when poured directly into the bulk of the water to give a concentration of 1 in 800 thiocyanate and 5 per cent. oil in the diluted wash.

This thiocyanate has been tested extensively in the United States, both as an ovicide and as a contact insecticide for greenhouse use,[1-7] * but there is no record of its having been tried in this or any other country on fruit trees. Jary and Austin,[8] however, have recently reported on its value against Red Spider on hops.

The dinitro-ortho-cresol was incorporated in the same grade petroleum oil as was used for the thiocyanate-oil wash, to give an easy-flowing, emulsion type product, referred to hereafter as DA. This could be diluted without difficulty, by simply pouring into the bulk of the water, and was used throughout at a concentration of 7 per cent. As long ago as 1926,[9,10] it was shown that dinitro-ortho-cresol was highly efficient as an ovicide for the control of Aphis, Sucker and Winter Moth Caterpillar and had a marked cleansing effect on the trees, killing moss and lichen.

Both FL and DA washes were tried out on a large scale throughout the main fruit-growing areas and in only one instance did any damage to apples occur, the thiocyanate wash causing some scorching when applied after the green bud stage. This wash was also tried very late on black currants, when the flower trusses were showing and the bushes were almost ready for the first lime sulphur application; here a definite scorching of the blossom trusses occurred. Neither wash caused damage when applied to black currants when the buds were just bursting and before the blossom trusses showed at all.

In the tables below the figures represent the number (or percentage) of Aphis, Capsid and Caterpillar-infected shoots per tree or part tree, while the Woolly Aphis figures represent the number of Woolly Aphis patches per tree or part tree. Unfortunately, in both years, there was not sufficient crop to make the counts of Capsid-marked fruits of any value. The counts made at all centres were conducted under the personal supervision of the writer.

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* For references, see p. 940

The figure for the percentage reduction in infestation, given in the tables below, is calculated from the result obtained with each wash, compared with the result on the adjacent, unsprayed control trees. Where possible, the results obtained from a standard tar or petroleum wash have been given for comparison.

Centre 1. Burwell, Cambs. Washes applied March 5, 1937, to large, unsprayed Bramley trees, 8-10 ft. high and 20 ft. spread. Buds just beginning to break (green tip stage). No hatched Aphis seen. The washes were applied by ¾ h.p. petrol pump at 250 lb. pressure, supplying two single nozzle spray guns. There was a strong wind, making good spraying difficult. The Caterpillars on these trees were partly Winter Moth and partly Tortrix (chiefly *Cacoecia podana*, Scop.). The figures in Table I were based on counts made on each tree up to a height of 7 ft. At this centre, wash A was a miscible type petroleum oil, applied at a concentration of 6 per cent. oil in the diluted spray; wash B was a miscible type tar oil, applied at a concentration of 2.5 per cent. neutral tar oil in the diluted wash; Wash C was a "two solution" thiocyanate-containing non-oil preparation, applied to give the same concentration of thiocyanate in the diluted wash as with FL.

TABLE I

Treatment	No of Trees	Average No of Marked Shoots per Tree (7 ft)				Percentage Reduction in Infestation			
		Aphis	Woolly Aphis	Capsid	Cater-pillar	Aphis	Woolly Aphis	Capsid	Cater-pillar
DA	11	1	16	20	20	99	85	88	87
Control ..	5	*169*	*113*	*170*	*160*	—	—	—	—
FL	6	18	16	5	35	86	88	96	78
Control ..	5	*129*	*131*	*194*	*155*	—	—	—	—
Petroleum A ..	9	63	32	24	75	56	78	88	53
Control ..	7	*145*	*114*	*214*	*160*	—	—	—	—
Tar B	6	2	53	183	60	99	69	24	68
Control .. .	6	*161*	*164*	*240*	*185*	—	—	—	—
Thiocyanate C	6	11	71	106	140	92	32	46	7
Control ..	3	*141*	*104*	*197*	*150*	—	—	—	—

Centre 2. Holwellbury, Herts. (*a*). Washes applied February 23, 1938, to small, unsprayed Lanes, by ¾ h.p. petrol pump at 250 lb. pressure, supplying two single nozzle

spray guns. Trees well sprayed, under good weather conditions; buds swelling but not yet in green tip stage; no hatched Aphis seen. The figures in Table II were based on counts made on the whole of each tree. Wash D (an emulsion of the oil used in DA) was applied at a rate giving the same oil content in the diluted wash, as DA. Wash B was a miscible tar oil wash, applied at 2.5 per cent. neutral tar oil in the diluted wash. Unfortunately, Aphis was the only pest present sufficiently widespread to make counts worth while.

TABLE II

Treatment	No. of Trees	Average No. of Aphis-marked Shoots per Tree	Percentage Reduction in Aphis Infestation
DA	27	0	100
Petroleum D	8	9	44
Tar B	5	0	100
Control	*32*	*16*	—

(*b*). Washes applied January 24, 1938, to unsprayed, Kentish-bush plums; tall trees, not very well sprayed at top, owing to strong wind; buds still dormant; no hatched Aphis seen. The figures in Table III were based on counts made on the whole of each tree. Wash D was applied to give the same concentration of oil in the diluted wash as DA.

TABLE III

Treatment	No of Trees	Average No of Marked Shoots per Tree		Percentage Reduction in Infestation	
		Aphis	Caterpillar	Aphis	Caterpillar
DA	10	20	40	94	86
Petroleum D ..	10	60	90	82	68
Control	*10*	*340*	*280*	—	—

CENTRE 3. ASH, KENT. (*a*). FL wash applied March 22, 1938, to unsprayed, half-standard Bramleys, using 8 gal. per tree, at 350 lb. pressure, under good weather conditions; buds in delayed dormant stage; a few hatched Aphis seen; two widely separated blocks sprayed in same orchard. The figures in Table IV are based on counts of the total number of Aphis-infected shoots, and total number of Woolly Aphis

patches per tree. Wash B was a miscible type tar oil wash, diluted to give 2.5 per cent. neutral tar oil in the diluted wash. This wash was applied in February.

TABLE IV

Treatment	No of Trees	Average No. of Woolly Aphis Patches per Tree	Average Percentage of Shoots per Tree Infected by Aphis	Percentage Reduction in Infestation	
				Woolly Aphis	Aphis
FL	7	22	1	93	98
Tar B ..	4	111	0	65	100
Control ..	*3*	*319*	*40*	—	—
FL	5	20	4	84	93
Tar B ..	3	—	0	—	100
Control ..	*2*	*126*	*56*	—	—

(*b*). DA wash, applied to small bush plums on February 4, 1938, at 350 lb. pressure, under good weather conditions, gave very variable results. On some trees the control of Aphis was perfect, on others very poor. As, in addition, the Aphis infestation on the control trees was variable, no counts were taken. No explanation could be given for this apparent lack of Aphis control.

Centre 4. Stockton, Worcester. Very large, standard Derbys, not previously sprayed this year. All washes were applied at 300 lb. pressure, using two spray guns, under good weather conditions. The trees were well sprayed, about 17 gal. being required per tree. Wash DA was applied on February 8, 1938, when buds were swelling. Wash FL was applied on March 23, 1938, when buds were in late green bud stage. Wash DL was a thiocyanate-containing miscible oil preparation made with a different emulsifier, but applied to give the same concentration of thiocyanate and oil in the diluted wash as Wash FL. A miscible petroleum wash A was applied on March 14, in the late delayed dormant stage, to give 6 per cent oil in the diluted wash. These trees had previously been sprayed with a tar-oil winter wash in the dormant stage. In addition, other varieties were sprayed with all these washes, but the infestation on the control trees was not sufficient to warrant taking counts, except on the Derbys. The counts below represent the total number of marked shoots per tree.

TABLE V

Treatment	Date of Application	No. of Trees	Average No. of Marked Shoots per Tree		Percentage Reduction in Infestation	
			Aphis	Capsid	Aphis	Capsid
DA	8/2	3	0	19	100	92
FL	23/3	3	7	17	93	93
DL	23/3	3	15	25	86	90
Tar wash followed by A	14/3	4	0	41	100	84
Control	—	*3*	*107*	*259*	—	—

At this centre, Wash DA and petroleum wash A caused no damage, but Washes FL and DL, which were applied too late, caused some scorching. On March 14, when petroleum wash A was applied, the buds were already so far advanced that later spraying could not be recommended with safety.

CENTRE 5. WATERINGBURY, KENT. Standard Derbys, not previously sprayed for two years; washes applied with portable two-throw pump at 180 lb. pressure, under good weather conditions. Wash FL was applied on March 15, with trees in delayed dormant stage. About three weeks earlier, some trees were also sprayed with miscible petroleum oil A, applied at a concentration of 5 per cent. oil in the diluted wash. The figures in Table VI were obtained by counting the total number of shoots and the number of Capsid-marked shoots, on a 4-ft. length of each of 10 branches, selected at random round each tree. As the infestation of Aphis and Caterpillar on the control trees was not sufficiently high to warrant taking counts, only the figures for Capsid control are given.

TABLE VI

Treatment	No. of Trees	No. of Shoots Counted	Average percentage of Shoots Marked by Capsid	Percentage Reduction in Capsid Infestation
FL	6	3,204	6	90
Petroleum A .	4	1,744	21	66
Control	*2*	*817*	*62*	—

The poor control given by the miscible petroleum oil A was in all probability due to the early application and to the fact that the trees had not been sprayed with a tar oil wash for

two years. The petroleum wash should therefore have been applied at a higher concentration.

CENTRE 6. SITTINGBOURNE, KENT. Large, standard Beauty of Bath, not previously sprayed this year. The wash was applied on March 15, 1938, in late delayed dormant (mouse ear) stage; pressure 350 lb.; good weather conditions; average of 10 gal. spray used per tree. The figures in Table VII were based on counts of the total number of shoots, and the number of Capsid-marked shoots, on selected branches round each tree. There was not enough Aphis or Caterpillar infestation on the unsprayed trees to warrant taking counts.

TABLE VII

Treatment	No of Trees	No. of Shoots Counted	Average Percentage of Shoots Marked by Capsid	Percentage Reduction in Capsid Infestation
FL	6	3,720	14	82
Control	*3*	*1,281*	*77*	—

CENTRE 7. BRIDGWATER, SOM. Small bush trees, variety Rival, underplanted with black currants; washes applied at 450 lb. pressure, in good weather and good growing conditions; approximately 1¼ gal. used per tree. Wash DA was applied on February 21; apple buds swelling, black currants showing green at tips. Wash FL was applied on March 12; condition of buds not noted. The figures in Table VIII were based on counts made of the total number of Aphis and Capsid-marked shoots per tree.

Neither wash DA nor wash FL caused any damage to the black currants.

TABLE VIII

Treatment	No. of Trees	Average No. of Marked Shoots		Percentage Reduction in Infestation	
		Capsid	Aphis	Capsid	Aphis
FL	51	0	1	100	98
DA	43	12	4	60	90
Control	*47*	*29*	*40*	—	—

CENTRE 8. CROXTON, CAMBRIDGE. (*a*) Large, standard Bramleys. The washes were applied under good weather conditions, at 350 lb. pressure, wash DA on February 22, 1938, and wash FL on March 8, 1938; condition of buds not noted. The figures in Table IX were based on counts made of the total number of Aphis-marked shoots per tree. There was insufficient Caterpillar or Capsid infestation on the unsprayed trees to warrant taking counts.

TABLE IX

Treatment	No. of Trees	Average No. of Aphis-marked Shoots per Tree	Percentage Reduction in Aphis Infestation
FL	25	60	93
DA	30	24	97
Control	*14*	*866*	—

(*b*). Small bush trees, mixed varieties, sprayed on March 11, 14 and 15, under good weather conditions, with ¾-h.p. petrol pump, at 250 lb. pressure, supplying two single-nozzle spray guns. The buds on some varieties were swelling, others were at green tip and some at delayed dormant stage. The various treatments were as follows:—

A = Miscible petroleum wash A, applied to give 5 per cent. oil.
A1 = Thiocyanate in same miscible petroleum, applied to give 5 per cent oil and 1 in 800 thiocyanate
D = Emulsion petroleum wash, applied to give 5 per cent. oil
D1 = Thiocyanate in same petroleum emulsion, applied to give 5 per cent. oil and 1 in 800 thiocyanate

The figures in Table X were based on counts of the total number of Aphis and Caterpillar-marked shoots per tree. The Caterpillar was chiefly Winter Moth, with a few Tortrix.

TABLE X

Treatment	Percentage Oil in Diluted Wash	Thiocyanate in Diluted Wash	No of Trees	Average No. of Marked Shoots per Tree		Percentage Reduction in Infestation	
				Aphis	Cat	Aphis	Cat.
A	5	0	8	66	20	51	84
A1	5	1 in 800	7	2	0	98	100
Control ..	—	—	*20*	*136*	*125*	—	—
D	5	0	8	35	45	74	69
D1 .. .	5	1 in 800	8	4	15	97	90
Control ..	—	—	*20*	*134*	*145*	—	—

Summary. In the above experiments the thiocyanate-oil wash FL, applied to apples in the green tip and delayed dormant stage, gave a good control of Aphis, Capsid and Woolly Aphis and also reduced the infestation of Caterpillar, without causing damage to the trees. At one centre, when applied in the late green bud stage to apples it caused some scorching, but the date of application was later than would be recommended for this wash.

In comparison with a miscible tar oil wash, the thiocyanate-oil wash gave slightly inferior Aphis control, but better control of Woolly Aphis.

In comparison with a miscible petroleum oil wash, the thiocyanate-oil wash gave better control of Apple Capsid. The thiocyanate alone, in a non-oil base, gave a good control of Aphis, but had only a slight effect on Woolly Aphis and Capsid and practically no effect on Caterpillar.

Petroleum oil alone, in both miscible and emulsion forms, gave a certain measure of control of Aphis and Caterpillar, but the addition of thiocyanate greatly increased the toxicity of the wash.

The dinitro-ortho-cresol wash DA, at 7 per cent., proved an efficient Aphis ovicide at 5 centres, slightly superior to the thiocyanate-oil wash and in no way inferior to a tar oil wash. At one centre wash DA proved slightly inferior to the thiocyanate-oil wash and, at another, it gave very variable results against Aphis.

At two centres it gave better results than a petroleum oil wash against Caterpillar.

Against Capsid, in comparison with the thiocyanate-oil wash, it gave similar results at one centre, slightly inferior results at another, and markedly inferior results at a third.

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DECEMBER ON THE FARM

R. W. WHELDON, D.Sc.,
King's College, Newcastle-upon-Tyne

Little daylight and short working days out-of-doors are characteristics of the present month. Occasionally a favourable spell of weather permits ploughing, or frost allows for dung carting, but, in the main, major operations do not figure largely in the work of the month. On most farms plans have been made for the cropping of 1939 and the farmer is chiefly concerned with marketing what may remain of the 1938 crop. The major part of the hay, straw and roots remains to be consumed on most farms, and the problem of how to obtain the best returns from these home-produced foodstuffs requires careful consideration. Concentrated foods, both home-grown and purchased, are relatively cheap, but it is important that the fullest possible use should be made of home-grown crops. Care in selecting suitable concentrates to feed with farm roughages can do much to help in this respect. A study of the returns obtained for food fed to stock on several farms during last winter indicates a great difference in the amount received for food fed. Even on farms where both farm-produced food and the class of product aimed at were the same a marked difference in return was obtained. All feeders do well to consider what cash return they obtain for food fed to stock, and where this proves to be unsatisfactory special consideration should be given to the different factors involved.

From Grass to Corn. There is a great deal of stored-up fertility in large areas of grass land, and frequently some of the best grass is found on soils well suited to cereal growing. This is true in the north of England as in other parts of the country. Experience of long leys has indicated that, with proper seeding and management, the first 6-10 years of the life of a ley are the most productive, some deterioration setting in on many soils after leys have been down for this time. This fact has led many farmers to consider the breaking up of these leys at the end of a period of years. The advantages are that good arable crops can then be obtained, afterwards

followed by a vigorous, productive new ley which is clean and healthy for stock. In areas where land has been down to grass for a long time the problem of breaking up first-class pastures has not proved so simple. The tendency for cereal crops to lodge owing to the large amount of nitrogen present in the soil has resulted in farmers considering alternative crops. Swedes and potatoes are alternatives which have been tried —in some instances with a measure of success.

As far as roots are concerned, an enormous amount of cultural work is often necessary before suitable soil conditions and a fine seed bed can be obtained for the seed, and even when these are obtained the tendency for the crop to grow rapidly and produce an abnormal amount of top without corresponding root formation is often most marked. Potatoes can usually be grown satisfactorily, but it often happens that suitable labour is not available for handling the crop. This problem of the supply of labour skilled in the management of arable land is one which is becoming rather serious in localities where land was laid down to grass years ago and skilled labour has either died out or left the industry.

It is well recognized that the cultivation of land is something of an art, and not only does it require men skilled in the handling of implements but suitable direction is also needed. It is probably true to say that larger acreages of land would be brought under the plough and a system of alternate husbandry adopted more widely in certain areas if the skilled labour problem was less acute and the risks associated with the breaking up of good pastures were not so great.

Attention to selection of not only the right crop but also the right varieties, especially of cereals, are matters which may help. The greatest trouble from lodging would appear to occur on pastures containing a large amount of wild white clover, and which have been heavily stocked in the season prior to ploughing out. This tendency to lodge is no doubt due, not only to the nitrogen obtained from the clover root, but also to the available nitrogen found in the dung and urine left by the grazing stock. It is possible that this latter source of nitrogen is most largely responsible. At Cockle Park for a number of years a cereal crop has been taken after good wild white clover leys, and the liability to lodge has not been serious, but a hay crop has invariably been taken in the year preceding the ploughing out for corn. Where this can be

arranged, it is very probable that much could be done to reduce the risk of lodging after good leys.

Wheat would normally be favoured as a cereal crop at the present time on account of the price obtainable and because of its high food value at a time of emergency. Where leys have been down for a considerable number of years, the amount of fibre in the soil frequently makes it difficult to get the seedbed firm enough for wheat. The presence of this fibre may persist for one or two years after ploughing. It has been noted that failure to get a good plant established that will persist through the spring, even on stiff soils that would normally be regarded as suitable for wheat, is experienced in the second year after ploughing. The breaking down of turf depends on air and moisture in the soil and it sometimes happens that the turf breaks down more slowly on stiff soils than on some of the lighter ones, especially if there is a tendency to acidity. It is true that management of cultivations, heavy rolling, etc., may help, but the risk of failure to obtain a suitable stand of wheat in the spring of the year must not be overlooked when good leys are ploughed out, even on soils that would normally be regarded as suitable for wheat.

Generally speaking, best results are obtained when leys have not been down for a period of more than five or six years. From many points of view, alternate husbandry has much to commend it. A reasonable amount of land under the plough provides good winter keep for stock and helps to maintain a better balance between the summer and winter food supply on the farm, which is a great advantage in stock management.

Land Fertility Scheme. There are many indications that farmers are making the fullest use of the provisions made for cheap fertilizers under the Land Fertility Scheme. Unfortunately, the supplies of basic slag are restricted and do not satisfy the demand. This has, in many instances, caused farmers to consider lime as an alternative, but it should be remembered that if phosphates are needed lime is not a suitable alternative to basic slag.

In some circumstances a dressing of lime may give a profitable return if used to replace basic slag, but if it has been ascertained that phosphates are needed, and it is always desirable that steps should be taken to find out what fertilizer

is required before money is spent, then an alternative phosphatic manure, such as superphosphate, steamed bone flour or mineral phosphate, would be advisable.

Lime should be used only on soils known to suffer from a lime deficiency, and even when chemical analysis indicates some slight acidity the most economical results may not be obtained from lime on grass land. At Cockle Park, lime applied to permanent grass land has failed to give an economic return. Results of a study of the effects of manurial treatment and of age on the carotene content of grass, carried out by Thomas and Moon, and published in the *Empire Journal of Experimental Agriculture,* July, 1938, indicate that a dressing of carbonate of lime may have an adverse effect on dry matter yield from pasture. There can be no doubt that large areas of land need lime, but it is most important that it should be utilized where it will give a return. If lime is not needed, no matter how cheaply it may be obtained, it will not give an economic return to the farmer.

Costs of Milk Production. The anxiety which milk producers have experienced during recent years on account of high feeding costs gives special interest to a report recently issued by the Farm Economics Branch of King's College, presenting evidence on winter costs of milk production in the northern counties during the last three years. The report deals with the costs on a total of 29 herds, and the investigation is limited entirely to costs relating to the milking herd.

The information obtained from investigations of this kind is most helpful from the administrative point of view, giving as they do what may be regarded as an average figure for costs under the conditions pertaining to the locality and indicating the trend of costs at any particular time. While such average figures are helpful from many points of view, it cannot be too strongly emphasized that these averages invariably represent wide variations in range in individual cases. Group averages undoubtedly provide a useful starting point for diagnosis, but from the standpoint of herd efficiency the farmer must regard the problem from the point of view of his particular circumstances. Reports published in this way are intended for general consumption and the individual farm must always be regarded as a problem in itself, and farmers are, therefore, well advised to get in touch with the local

Advisory Economist for assistance in connexion with their own enterprises.

A factor of special interest in the report, in view of discussions during the past season with reference to the price of milk, is the fact that the figures reveal an average increase in net farm costs of 2.47*d.* per gal. between 1935 and 1938, the figures being 9.03*d.* (1935-36), 10.7*d.* (1936-37), 11.5*d.* (1937-38). The cost of food, purchased and home-grown, was 6.57*d.*, 7.71d., 9.07*d.* per gal. These average figures, however, show a wide variation, the lowest net cost being 6*d.* per gal. and the highest 15.4*d.* per gal. in 1935-36, and in 1937-38 the lowest cost was 8*d.* per gal. and the highest 16.3*d.* per gal.

The report indicates clearly that each item needs to be considered in relation to the whole; for example, the average costs per cow for winter maintenance on the Durham group of farms is considerably higher than the cost for maintenance on farms in the Cumberland and Westmorland group, but the average production per cow is also higher in Durham, resulting in a lower net cost per gallon.

The report, which is obtainable from the Advisory Economist, King's College, provides evidence of the usefulness of this kind of investigation, as it not only gives much interesting information but provides a standard by which farmers can compare their own costs, and in many cases may provide a basis for adjustments in connexion with particular branches of production.

MISCELLANEA

Livestock Improvement, 1937-38—II*

Milk Recording. Membership of Milk Recording Societies showed a further increase in 1936-37, and the number of cows recorded was the highest since the inception of the scheme. (See Table IX.)

TABLE IX.—NUMBER OF MILK RECORDING SOCIETIES, MEMBERS, HERDS AND COWS

Year ended October 1	*Societies*	*Members*	*Herds*	*Cows*
1917–18 ..	27	639	708	19,793
1918–19	38	1,191	1,332	37,880
1919–20 ..	46	2,075	2,312	61,323
1920–21 . .	52	3,328	3,664	97,903
1921–22 ..	55	3,949	4,362	117,023
1922–23	55	4,365	4,767	127,151
1923–24	52	4,764	5,209	138,086
1924–25 .. .	50	5,081	5,516	148,905
1925–26 .. .	49	5,174	5,656	154,322
1926–27 .. .	51	5,166	5,650	156,847
1927–28 .. .	50	4,862	5,320	149,971
1928–29 ..	50	4,616	5,065	144,812
1929–30 ..	49	4,501	4,934	140,266
1930–31	49	4,412	4,836	137,866
1931–32	49	4,267	4,682	135,912
1932–33 .. .	49	4,187	4,598	135,902
1933–34 ..	49	4,211	4,622	141,325
1934–35	49	4,264	4,696	148,426
1935–36	49	4,355	4,792	156,268
1936–37	49	4,399	4,845	159,390

Average Yield of Recorded Cows. The milk yields during the year (see Table X) were adversely affected by the rather poor hay harvest of 1936, and also to some extent by the high price of feeding stuffs. The average yield of cows recorded for the full year was 721 gal. compared with the record of 741 gal. set up in the previous year. This reduction of 20 gal. amounts to less than 3 per cent. on the year, and in all the circumstances must not be considered unsatisfactory.

Notwithstanding the decrease in yields throughout the country, increased average yields were obtained by 8 Societies, viz., Lincolnshire, Pembrokeshire, Durham County, Cumberland and North Westmorland, Glamorgan, East Devon, Staffordshire and Norfolk. The increased yield by the Lincolnshire Society, with an average of 8,351 lb. (808 gal.), amounted to 601 lb. (58 gal.), which was an excellent performance, while at 7,153 lb. (692 gal.) the Pembrokeshire Society's increase of 277 lb. (27 gal.) is also noteworthy.

* Part I appeared in the November, 1938, issue of this JOURNAL.

TABLE X.—AVERAGE YIELD OF RECORDED COWS

Year Oct. 1 to Oct. 1	Particulars of all Cows and Heifers Recorded			Particulars of Cows Recorded for Full Year			
	No. of Cows and Heifers	Total Yield	Average Yield*	No. of Cows	Percentage of Total Cows and Heifers	Total Yield	Average Yield*
		Gal.	Gal.			Gal	Gal.
1917–18	19,793	8,426,958	426	8,775	44	5,255,923	599
1918–19	37,880	16,204,941	450	17,989	47	10,543,516	579
1919–20	61,323	29,344,887	479	27,266	44	17,363,347	637
1920–21	97,903	48,512,380	495	48,248	49	30,892,620	640
1921–22	117,023	60,463,617	517	63,318	54	41,208,073	651
1922–23	127,151	67,904,224	534	68,349	54	46,956,565	687
1923–24	138,086	73,963,165	535	73,338	53	50,299,884	685
1924–25	148,905	76,419,498	513	77,132	51	51,695,291	670
1925–26	154,322	81,623,788	529	81,669	53	56,102,434	687
1926–27	156,847	82,161,809	524	81,749	52	55,677,261	681
1927–28	149,971	76,896,131	513	77,171	51	51,931,633	673
1928–29	144,812	75,948,485	524	74,171	51	51,207,594	690
1929–30	140,266	75,293,001	537	71,432	51	50,766,464	711
1930–31	137,866	75,357,035	547	71,480	52	51,386,105	719
1931–32	135,912	73,793,049	543	70,826	52	50,243,265	709
1932–33	135,902	73,422,655	540	73,328	54	51,300,933	700
1933–34	141,325	76,274,826	540	74,493	53	52,423,417	704
1934–35	148,426	82,661,157	557	76,178	51	55,921,162	734
1935–36	156,268	87,862,328	562	78,757	50	58,339,461	741
1936–37	159,390	87,059,467	546	79,971	50	57,677,869	721

Before 1924–25 the average yield was calculated at the equivalent of 10¼ lb. to a gallon, and subsequently at 10⅓ lb.

Averages in excess of 8,000 lb. (774 gal.) were obtained by 4 Societies, compared with 8 last year. These were Norfolk, Lincolnshire, Derby and District, and Essex. Twelve Societies had average yields between 7,500 lb. (726 gal.) and 8,000 lb. (774 gal.) compared with 20 last year, but Societies with between 7,000 lb. and 7,500 lb. rose from 12 to 21. The average yields of the remaining 12 Societies were below 7,000 lb. (677 gal.).

Individual herds with average yields for full-year cows of 8,000 lb. (774 gal.) or over numbered 1,421 or 32 per cent. of the total number of herds recorded for the full year, as compared with 1,576 or 36 per cent. in the previous year. Herds with average yields of 10,000 lb. (968 gal.) or over numbered 280 against 353 in 1935-36, while 21 herds had average yields of over 13,000 lb. (1,258 gal.), compared with 32 in 1935-36.

The total number of cows and heifers of certain breeds recorded during the year, and the number and average yield of the cows recorded for the full year, together with the percentage of full year cows are shown in Table XI. The number of Ayrshires recorded increased by 1,744, as compared with 1935-36, while Friesians increased by 1,225 and Guernseys by 1,142. Shorthorns, however, decreased by 1,330, although they still account for 53 per cent. of the total cows recorded. Notwithstanding the general decline in milk yields, Devons and Lincoln Reds showed increases in the average yield for full year cows of 175 lb. and 77 lb. respectively. All the other breeds had reduced average yields, Shorthorns averaging 7,146 lb. against 7,382 lb., a reduction of 236 lb., and Friesians 9,167 lb. against 9,418 lb., a reduction of 251 lb.

TABLE XI

Breed or Type	Total Number of Cows and Heifers Recorded	Particulars of Cows Recorded for Full Year			
		Number	Percentage of Total of Cows and Heifers	Total Yield	Average Yield
				lb	lb
Ayrshire .	9,982	4,692	47·0	35,127,701	7,487
Blue Albion .	458	257	56·1	1,981,116	7,709
Devon.. ..	651	385	59·1	2,363,095	6,138
Friesian .	27,155	14,516	53·5	133,066,336	9,167
Guernsey .	14,951	7,218	48·3	49,113,831	6,804
Jersey.. .	9,078	4,619	50·9	30,368,385	6,575
Lincoln Red ..	2,073	1,047	50·5	7,614,465	7,273
Red Poll ..	7,013	4,127	58·8	29,951,325	7,257
Shorthorn .	84,157	41,176	48·9	294,238,932	7,146
South Devon ..	1,995	954	47·8	6,293,090	6,597
Welsh Black .	751	405	53·9	2,159,528	5,332

Issue of Certificates. The number of Certificates of Merit issued for the three years ended October 1, 1937, was 703, as compared with the record of 733 set up for the previous three-year period. Although this is a decrease of 30, the number of certificates issued during the year in respect of earlier three-year periods was 52, an increase of 19. Certificates of Merit are awarded on application by the owner, and on payment of a fee of 5*s*. for each Certificate, for cows that have given during a period of three consecutive Milk Recording Years the prescribed yield of milk for their breed or type and have been shown to be regular breeders. The number of members

who obtained Certificates of Merit was 205, compared with 221 for the previous year. Certificates issued in respect of the three-year period ended October 1, 1937, numbered 130 for Friesians, an increase of 22, and 118 for Jerseys, an increase of 15. Shorthorns, with a total of 192, showed a decrease of 3; Guernseys, with 123, a decrease of 32; and Red Polls, with 94, a decrease of 37. The highest yields certified for the various breeds were: Friesian, 75,156¾ lb.; Shorthorn, 54,694¾ lb.; Guernsey, 45,715½ lb.; Red Poll, 43,885¼ lb.; and Jersey, 43,059 lb. With the exception of Red Polls, all these yields show increases as compared with those of the previous period, and in the case of the Friesian, which is owned by a member of the Essex Society, the figure of 75,156¾ lb. (7,273 gal.) is the highest for which a certificate has been issued since the inauguration of the scheme.

Register of Dairy Cattle. Vol. XXI of the Register of Dairy Cattle was published in August, 1938, and contains particulars of 755 cows in respect of which Certificates of Merit have been issued since the publication of Volume XX, and also particulars of 15 pedigree bulls that have qualified for entry on the basis of the yields given by their dams and sires' dams.

Testing for Butter-fat. The Ministry's Scheme for Butter-fat Testing has now been in operation for four years, during which time the number of cows tested has increased steadily. The number of members having cows tested in 1936-37 was 956, compared with 927 in 1935-36 and 854 in 1934-35; 82.5 per cent. of the herds tested consisted wholly or mainly of pedigree cattle. Testing was carried out in 1,050 herds containing nearly 33,000 cows, the number of cows actually tested being 13,533, compared with 12,597 in 1935-36 and 11,583 in 1934-35.

All the breeds show increases in the number of cows tested, except Shorthorns, which again show a small decrease. An average of over 5 per cent of butter-fat was reached by 1,889 cows, practically all of which were Jerseys and Guernseys, compared with 1,660 in 1935-36, while 3,942 averaged between 4 and 5 per cent., against 3,603 in 1935-36. The average percentage of butter-fat for all animals tested was 3.93, a small increase compared with the previous year, and there was a corresponding increase in the average percentage of all the

principal breeds tested, except Guernseys, which remained unaltered. Jerseys again obtained the highest average with 5.05 per cent., while Guernseys averaged 4.61 per cent. and Ayrshires 3.81 per cent.

TABLE XII.—NUMBER OF COWS TESTED FOR BUTTER-FAT UNDER THE MINISTRY'S SCHEME DURING THE YEAR ENDED OCTOBER 1, 1937, CLASSIFIED ACCORDING TO BREED AND PERCENTAGE OF BUTTER-FAT

Breed or Type	Percentage of Butter-fat								Total Number of Cows Tested	Average Percentage of Butter-fat
	Under 3	3 to 3 5	3 5 to 4	4 to 4 5	4 5 to 5	5 to 5 5	5 5 to 6	Over 6		
Ayrshire ..	5	259	730	395	53	5	1	—	1,448	3·81
Friesian ..	543	1,824	828	144	13	1	-	—	3,353	3·29
Guernsey ..	1	26	303	913	1,044	663	128	33	3,111	4·61
Jersey ..	—	6	41	231	502	548	365	135	1,828	5·05
Lincoln Red	—	39	103	32	6	1	—	—	181	3·72
Red Poll ..	42	228	394	146	15	2	—	1	828	3·64
Shorthorn ..	102	824	1,315	321	40	3	1	—	2,606	3·62
Other Breeds	2	26	61	63	24	2	—	—	178	3·97
TOTALS ..	695	3,232	3,775	2,245	1,697	1,225	495	169	13,533	3·93

Rationing. Reports received by the Ministry indicate that most members of Milk Recording Societies pay close attention to the rationing of their cows according to milk yield, and that generally good use is made of the advisory services available. In this connexion valuable assistance has been received from County Agricultural Organizers and agricultural institutions.

Calf and Bull Marking. Activities under the scheme for the ear-marking and registration of calves of milk-recorded cows were maintained, and a total of 16,536 calves were marked as compared with 16,454 in 1935-36. Heifer calves again constituted the great majority. Bull calves at 1,511 showed a decrease of 149 as compared with the previous year.

The number of bulls being used for service, and which were ear-marked and registered by Societies for their members, showed a marked decline to 10 against the previous total of 42.

Progeny Recording of Dairy Bulls. The Ministry has recently issued revised regulations relating to the scheme for Progeny Recording of Dairy Bulls. The record sheet has been remodelled to render it of more practical value to the breeder. It admits of the entry over four lactations of the milk yields and butter-fat records of the daughters of the bull,

TABLE XIII.—MILK RECORDING SOCIETIES

STATEMENT GIVING PARTICULARS OF THE 49 MILK RECORDING SOCIETIES OPERATING DURING THE YEAR ENDED OCTOBER 1, 1937

(The Societies are arranged in order of total numbers of Cows recorded)

Society	*No of Members	*No of Herds	Total No of Cows Recorded	No. of Cows Recorded for Full Year	Average Yield of Cows Recorded for Full Year
					lb.
Essex County	272	321	13,556	7,044	8,257
Suffolk	290	324	10,020	5,597	7,972
East Sussex	266	295	9,631	4,778	6,990
Hampshire	192	225	8,186	4,107	7,008
Berkshire	181	210	7,690	4,149	7,144
Somerset and North Dorset	179	205	7,090	3,816	7,200
Hertfordshire County	178	195	6,666	3,410	7,851
Norfolk	195	216	6,610	4,023	8,362
Kent	139	164	5,351	2,887	7,150
West Sussex	121	139	4,857	2,522	7,273
Lancashire County	94	102	4,488	1,567	7,469
Surrey	132	145	4,169	1,961	6,978
North Wilts	74	84	4,021	2,102	6,911
Gloucestershire	120	133	3,816	1,939	7,155
Oxfordshire	94	104	3,694	1,803	7,179
Leicestershire and Rutland	89	98	3,320	1,502	6,994
Yorkshire	106	110	3,202	1,420	7,962
Shropshire	72	77	3,171	1,460	7,407
Warwickshire	94	99	3,165	1,389	7,317
Buckinghamshire	100	108	3,123	1,483	7,419
Cambridgeshire and District	89	102	3,016	1,502	7,482
Dorset	50	69	3,012	1,721	7,019
Staffordshire	81	82	2,691	1,159	7,908
Northamptonshire	74	78	2,674	1,199	6,917
Nottinghamshire	55	58	2,498	1,077	7,501
Cheshire County	56	59	2,372	1,039	7,677
South Devon and District	88	89	2,090	981	6,651
Bristol and North Somerset	67	73	2,057	1,109	7,391
Derby and District	60	63	2,036	890	8,336
Cumberland and North Westmorland	79	81	1,994	766	6,576
Bedfordshire	54	57	1,924	966	7,703
South Wilts	36	44	1,849	1,098	7,325
Peak	56	58	1,803	741	7,759
Durham County	50	53	1,802	818	7,532
Worcestershire	59	61	1,587	724	7,564
Northumberland	41	44	1,489	836	7,212
Lincolnshire	29	30	1,285	595	8,351
Monmouthshire and Brecon	26	27	906	428	7,428
East Devon	43	43	850	509	6,668
Carmarthenshire	29	30	811	413	7,176
Cornwall	48	48	798	452	7,010
Campden, Moreton and District	30	30	734	360	7,436
Kendal and South Westmorland	26	27	675	270	6,122
Anglesey and Caernarvonshire	45	45	660	357	5,446
Denbighshire and Flintshire	24	24	657	317	6,782
Herefordshire	24	24	547	262	7,598
Pembrokeshire	15	15	296	188	7,153
Glamorgan	12	12	238	107	7,942
Cardiganshire	19	19	213	128	6,403
TOTALS	4,353	4,799	159,390	79,971	7,453

* Herds of Goats are not included.

and for purpose of comparison provision is also made for the entry of the records of the daughters' dams for corresponding lactations. The entries are checked by the Recorder on his visits and, at least once annually, the record sheet must be sent to the Secretary of the Milk Recording Society for countersigning. It may afterwards be sent to the appropriate Breed Society for use in connexion with the Breed Progeny Registers. Records kept under the scheme should be of considerable use as a reliable guide to the performance of dairy bulls, and as an aid to the recognition of valuable sires as early as possible in their career. The Ministry accordingly hopes that the scheme will receive wide support and that it will meet the needs of breeders of dairy stock, for whom it has been specially designed.

Cost of Milk Recording. The average cost of milk recording remained practically unchanged. Members paid an average of 4*s*. 1*d*. per cow as in 1935-36, and the Ministry's grants averaged 1*s*. 9*d*. per cow as compared with 1*s*. 10*d*. for the previous year.

Seeds Act, 1920

The importance to the farmer of securing good seed of recognized quality needs no emphasis. The sale of the principal kinds of farm and garden seeds is regulated by the Seeds Act, 1920, which requires that the vendor shall give to the purchaser a declaration in writing as to the percentage of germination and purity, the presence of injurious weed seeds, the country of origin, and other specified particulars. No attempt, of course, is made to force the grower to use seed of a better quality than he wishes to buy, but he is placed in the position of being able to judge the value of the seed he purchases.

Many farmers may have been lulled into a sense of security by the operations of this Act, but the careful farmer will still find that it is worth his while to study the particulars he received with his seeds, particularly in respect of mixtures of grasses and clovers. If he has any doubt as to the quality of the seed, the Official Seed Testing Station will carry out a check test for the nominal charge of sixpence, provided the test is required for information only in respect of seed that the farmer himself is proposing to sow. (Instructions regarding the despatch of samples to the Official Seed Testing Station, and particulars of the fees charged for the examination of samples are given at the end of this note.)

It cannot be too strongly emphasized that the protection afforded by the Seeds Act to the farmer when buying his seeds applies equally to purchases he may make from another farmer as to those he may make from a seedsman. A farmer who sells any of the scheduled seeds without having them properly tested, and who fails to deliver to the purchaser a statement in writing setting out the prescribed particulars is just as liable to proceedings for an infringement of the Act as is a recognized seedsman.

For the purpose of checking the particulars declared on the sale of seeds, samples are taken by Inspectors of the Ministry and examined at the Official Seed Testing Station. In the season 1937-38 over 1,200 control samples were taken and in a number of cases it was found necessary to draw attention to irregularities of one kind or another in the statutory declaration.

The Official Seed Testing Station for England and Wales examines many thousands of samples of seeds every year. In 1937-38, the number of samples reached the record figure of nearly 37,000. The great bulk of the samples is sent to the Station by seed firms, but increasing numbers of farmers are taking advantage of the facilities offered by the Station.

In addition to the Official Seed Testing Station, there are now 78 private stations licensed by the Ministry to test seeds for the purposes of the Seeds Act. These stations are maintained solely for the testing of the seeds handled by the licencees; nevertheless, it is essential that there should be the greatest possible uniformity between the measures adopted by the private stations and the Official Station, and steps are taken periodically to ensure that the necessary high standard of work is maintained by all the private seed testing stations.

SEED POTATOES. The Seeds Act requires that on the sale and exposure for sale of seed potatoes a declaration should be given of the class, variety, size and dressing of the potatoes. In practice it is found that more trouble is experienced in securing that the prescribed particulars are correctly given for seed potatoes than is the case with any of the other seeds scheduled under the Act. The reason for this is largely that seed potatoes are frequently sold by tradesmen, such as small greengrocers, who stock them as a sideline during the short selling season and who are often found to be unfamiliar with the regulations. An even more difficult class of sellers to keep in touch with are persons who in some parts of the

country are understood to handle quite large quantities of Scotch seed potatoes on a commission basis.

Sales of seed potatoes at auction marts are also a source of constant difficulty, but reasonably efficient control of such sales is believed to be effected by the issue of posters setting out the requirements of the Act and Regulations, and also by visits by the Ministry's Inspectors when the sales are in progress.

PENALTIES. Failure to comply with the requirements of the Seeds Act and Regulations is an offence for which a fine may be imposed on summary conviction. Among the cases in which proceedings were taken by the Ministry during the year 1937-38 was one in which a control sample of White Clover seed taken by one of the Ministry's Inspectors on the premises of a retailer was found to contain over 20 per cent. of an injurious weed seed, whereas the Regulations prohibit the sale of seed containing more than 5 per cent. of such seed. The Court found the case proved, but accepted the defendant's explanation that a mistake had been made in completing the order and dismissed the case on payment of £3 costs.

In another case a dealer had committed offences against the Seeds Act and the Wart Disease of Potatoes Order in respect of a quantity of seed-size tubers picked out of a consignment of ware potatoes: the small tubers had been sold as seed without giving the particulars required by the Seeds Act, and a false certificate number had been quoted contrary to the provisions of the Wart Disease of Potatoes Order. A fine amounting to £6, together with £3 19*s*. 6*d*. costs, was imposed.

The investigation of a complaint reported by the Ministry to the Department of Agriculture for Scotland led to the prosecution by that Department of a Scottish merchant for making a false statement as to the size and dressing of a consignment of seed potatoes supplied to an Essex merchant. The defendant pleaded guilty and was fined £5.

The fees charged for testing at the Official Seed Testing Station are as follows :—

To Farmers. A report will be furnished to *bona fide* English and Welsh farmers at the rate of 6*d*. per sample on seed which the farmer himself is proposing to sow. Samples to be tested at the 6*d*. rate must be accompanied by an undertaking that the test is not required in connexion with a declaration for sale. In the case of tests which a farmer requires for the purpose of a declaration for sale, he is required to pay the fees chargeable to seedsmen.

To Seedsmen. From 2*s*. to 10*s*. per sample, according to the kind of seed.

Purity Tests only—

Clovers (including examination for presence of dodder)		s d.
	per sample	3 6
All other seeds	One half of the fee for a complete test.	

Each kind of seed must be enclosed in a separate strong envelope, and be forwarded either separately or in a well-made-up parcel addressed to the Chief Officer, Official Seed Testing Station, Huntingdon Road, Cambridge.

A convenient summary of the provisions of the Act and Regulations, showing in addition, details of the fees for testing at the Official Station and the size of seed samples to be sent, may be obtained free of charge on application to the Ministry at 10 Whitehall Place, S.W.1.

Fertilizers and Feeding Stuffs Act, 1926

The Fertilizers and Feeding Stuffs Act, 1926, requires sellers of any of the scheduled fertilizers and feeding stuffs to furnish a statutory statement containing certain prescribed particulars. The statutory statement has effect as a warranty and samples may be taken by an Official Sampler at the request of the purchaser for the purpose of testing the warranty. If the warranty proves to be false to the prejudice of the purchaser, the purchaser may take such action as he thinks fit to recover from the seller. The Act also provides that every parcel of a fertilizer or feeding stuff included in the First Schedule to the Act if exposed for sale, or if not exposed for sale, before being removed from the premises where it is so prepared, shall be marked in the prescribed manner with a mark or marks stating or indicating the particulars required by the Act to be contained in the statutory statement. Criminal proceedings may be taken for failure to mark such parcels, or for the application of false particulars. In this connexion it is of interest to record that at Tower Bridge (London) Police Court on October 11 the London County Council took proceedings against a London firm of merchants for an offence under Section 4 of the Act, in that before removing a parcel prepared for sale from their premises they failed to mark such parcel (feeding meat and bone meal) according to the Act with a mark indicating the particulars required by the Act. In convicting, the Magistrate said that this and similar Acts of Parliament were Public Policy Acts, and should, therefore, be rigorously enforced: in his view, the defendants had deliberately disregarded the Act, and would be fined £10 and £5 5*s*. 0*d*. costs.

The Cleaning of Eggs

Most egg packers are at some time or other confronted with the problem of the dirty egg. Generally speaking, they accept

dirty eggs and clean them before sale, and have to select the best method of cleaning. Some packers are in a position to refuse to accept dirty eggs from producers, who then either have to clean such eggs themselves or find an alternative market for them. It is, therefore, important that all packers should know the best method of cleaning dirty eggs, whether they clean them at the packing station or advise producers to clean them on the farm.

It is generally recognized that cleaned eggs do not keep well, but opinions differ as to the effect of cleaning by different methods, e.g., washing, the use of damp cloths, cleaning powders, etc.

RECENT EXPERIMENTS. During the past five years a number of investigations have been made and have included most of the methods of wiping and washing in commercial use. The most recent experiment was carried out in the spring of 1937 by the Department of Scientific and Industrial Research on behalf of the Ministry. In this, a total of 18,360 eggs, in units of 180 each, were candled, cleaned by the various methods under test, and stored in a warm, moist atmosphere, favourable to the development of rots, for 25 days. For purposes of comparison, two untreated units, one of clean eggs (eggs that had never been dirty) and one of dirty eggs that remained dirty throughout the test were stored along with the cleaned units.

The results indicate that:—

1 Cleaning by all the methods tried increases the number of rots
2 Washing in markedly alkaline solutions (e g , of washing soda or soap preparations) tends to increase the number of rots still further.
3. "Dry cleaning" with a moist cloth and, e g , "Vim" or sand gives the fewest rots

The experiments show the advantage of keeping eggs clean from the time they are laid, for although the eggs were all kept under conditions favourable to the development of rots, yet among those which had not required cleaning, none was rotten after 25 days. Of the methods of cleaning, that employing a damp cloth with "Vim" proved best, especially when the cloth was rinsed frequently.

A further important fact brought out by this experiment is that cleaning, even by the best method available, is harmful to keeping quality, *fewer rots being found among the eggs that were left dirty than among any of the cleaned eggs.*

GENERAL CONCLUSIONS. Allowing eggs to become dirty removes them at once from the highest grade of quality, and producers should do everything in their power to reduce dirty eggs to a minimum. Cleaning dirty eggs by any process adversely affects their keeping quality, and it is, therefore, in the interests of packers that "cleaned" eggs should be packed separately from clean eggs, and that a quick sale should be obtained for the former. Effective control of cleaned eggs on these lines is only possible where the cleaning is done at the packing station, and for this reason it may be desirable for packers to discourage the cleaning of eggs by producers.

The chief points to be remembered—and they are applicable both on the farm and at the packing station—are that:—

(1) Dirty eggs are best cleaned with a clean, damp cloth and an abrasive such as "Vim," sand or pumice powder.
(2) The cloth should not be too wet.
(3) The cloth should be rinsed frequently when in use.

Marketing Notes

NOTE. In view of the demands on our space, it has been decided to omit from future issues of the JOURNAL some of the material hitherto included in the "Marketing Notes." The statements regarding milk prices, cheese-milk and butter-milk prices, payments and Orders under the Wheat Act, 1932, payments, etc., in connexion with the Livestock Industry Act, 1937, regulations of the Potato Marketing Board, statistics of operations under the Sugar Industry (Reorganization) Act, 1936, and similar marketing matters are published in the *Agricultural Market Report,** to which reference should be made.

Livestock Industry Act, 1937: *Slaughterhouse Advisory Committee.* The Livestock Commission have appointed a committee consisting of three of their members, namely:—

Sir Francis Boys, K.B.E. (Chairman)
George Dallas, Esq., J.P.
Sir Harold Gibson Howitt, D.S.O., M.C., F.C.A.

to advise the Commission on the design, equipment and management of central slaughterhouses. The Committee have

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been authorized to co-opt other members from a panel of 24 persons who are specified in the Minute of Appointment.

Slaughterhouse Schemes. With a view to reaching a decision on the question of the location of the three experimental slaughterhouses to be provided under Part V of the Livestock Industry Act, 1937, the Livestock Commission have asked each of those local authorities and other bodies with whom they have been in informal consultation on the subject of experimental slaughterhouses, and who have not yet either submitted detailed proposals or intimated that they do not propose to proceed with the matter, whether they propose to submit detailed arrangements for the design, equipment and management of a proposed central slaughterhouse. The Commission have intimated that all such arrangements should be submitted to them not later than December 31, 1938.

National Mark Apple Scheme. The development of the National Mark Apple Scheme during recent years may be seen in the following figures:—

	No. of Authorized Packers	*Quantity Packed under National Mark Labels* *Tons*
1932–33	181	1,293
1933–34	220	1,213
1934–35	283	5,323
1935–36	284	1,245
1936–37	345	7,002
1937–38	367	5,000

The fluctuations are due to a large extent to the effects of weather conditions in the spring months, but the volume marketed under the National Mark has increased progressively with the increase in the production of quality apples. There is also ample evidence to show that the value of the standards and methods prescribed in the National Mark Scheme is being still more highly appreciated by growers and salesmen.

In recent years, marketing organizations have been established in Essex, Kent, Sussex and the West Midlands, their chief object being to maintain a constant supply of National Mark apples on the markets. Each of the organizations markets its fruit under its own common label, which combines the organization's trade mark and the National Mark.

National Mark Scheme for Cauliflower and Broccoli. At a meeting of the National Mark Vegetables Trade Committee

on October 18, 1938, the following amendments were approved:—

(*a*) One grade, "Selected," to be substituted for the existing three grades, "Selected Large," "Selected" and "Selected Summer";
(*b*) The minimum diameter of each head of cauliflower or broccoli to be 3½ in.;
(*c*) The variation in the diameter of the heads in any one container not to exceed 1 in.;
(*d*) The length of the wrapper leaves on each head not to exceed 5 in. from the surface of the curd except during the period May to September, when it may be increased to 9 in.

Effect has been given to these amendments in fresh regulations made under the Agricultural Produce (Grading and Marking) Acts, 1928, and 1931.

National Mark Dressed Poultry: *Grading and Marking of Turkeys and Geese, Christmas,* 1938. As in previous years, special arrangements have been made for the grading and marking with the National Mark of home-produced turkeys and geese for the Christmas trade. These arrangements are as follows:—

All authorized packers in the National Mark Dressed Poultry Scheme have been invited to undertake on a service charge basis, (*a*) to collect, kill, grade, mark, pack and consign home-produced turkeys and geese, or (*b*) to grade and mark turkeys and geese on producers' premises at agreed rates which will vary in accordance with the number of birds submitted for grading.

The scheme also provides for the temporary authorization of producer-dealers, dealers and other producers with an output of not less than 500 turkeys and/or geese, to apply, during the month of December, the National Mark subject to the usual conditions as to inspection. Producers who cannot reach this figure or who do not desire to obtain authorization to mark and grade their own birds, may either have their birds graded on the farm or may send them to a grading centre authorized for this purpose.

National Mark Publicity. Arrangements have been made for demonstrations to be given at Smithfield Fat Stock Show to be held at the Royal Agricultural Hall, Islington, on December 5-9.

At this show the Ministry will stage a demonstration of the operation of the Scheme for the direct sale of Fat Stock on a Grade and Deadweight basis. Live animals will be exhibited to illustrate the types of animals that will kill out at various carcass grades under the scheme.

Contracts for Purchase of the 1939 Crop of Sugar-Beet. The Sugar Commission announce that they have fixed the following prices for beet of the 1939 crop accepted for delivery at the factories of the British Sugar Corporation named below. (The corresponding prices for 1938 are shown in brackets.)

Factory	*Beet Price per Ton* 1939 s d	1938 s. d.
Bury St Edmunds	46 3	(43 0)
Cantley	46 3	
Ely	46 3	
Ipswich	46 3	
King's Lynn	46 3	
Peterborough	46 3	
Spalding	46 3	
Wissington	46 3	
Bardney	47 3	(43 0)
Colwick	47 3	
Felstead	47 3	
Kelham	47 3	
Allscott	48 3	(44 6)
Brigg	48 3	
Kidderminster	48 3	
Poppleton	48 3	
Selby	48 3	

The prices quoted above relate to beet properly topped and washed, having a sugar content of 15½ per cent. and will be subject to an addition or deduction of 3*d*. per ton in respect of each 0.1 per cent. by which the sugar content is greater or less than 15½ per cent. A bonus of 1*s*. 3*d*. per ton will be paid on all beet accepted by the Corporation for delivery to English factories in September, 1939, or after December 31, 1939, provided the grower has complied with the clause in the beet contracts regulating deliveries of beet. The Corporation will also continue to defray railway freight charges in excess of 7*s*. per ton on all sugar-beet accepted by the Corporation for delivery to the factories at Allscott and Kidderminster.

Apart from the increase in the beet prices, the only substantial alteration in the terms of the beet contracts relates to the arrangements for the supply of sugar-beet pulp to beet growers. In past years, growers have been entitled to a supply of pulp, amounting to not less than 1½ cwt. of pulp for each net ton of beet estimated to be delivered under contract, at a fixed forward price. With the increasing appreciation of the value of pulp as a feeding stuff the forward price arrangement has given rise to speculative enterprise which has seriously disorganized

the market. In these circumstances the Commission have decided that, whilst the beet grower who requires pulp for use on his own farm should continue to have a first claim on pulp supplies, he should be required in future to pay the net wholesale price. In fixing the beet prices for 1939, the Commission have thought it right to include a full allowance by way of compensation for the loss of a fixed forward pulp price.

The terms and conditions of the contract for beet consigned to the Scottish factory at Cupar will be determined shortly.

International Exhibition, Brussels

The 26th Annual Exhibition of Agricultural Machinery, Fertilizers and Seeds will be held, under the auspices of the Société de Mécanique et d'Industries Agricoles, at Brussels on February 12–19, 1939.

All enquiries should be addressed to the Société at 29 rue de Spa, Brussels.

FARM WORKERS' MINIMUM RATES OF WAGES

Agricultural Wages Board. At meetings held on October 24 and November 8, Orders were made affecting the wages of agricultural workers in the following counties, viz.. Bedford and Huntingdon, Cheshire, Leicestershire and Rutland, Northants and Soke of Peterborough, Yorkshire (East Riding, North Riding and West Riding), Carmarthen, Glamorgan, Merioneth and Montgomery For details of the rates and for the various conditions applicable to them, as well as for particulars of the overtime rates awarded, reference should be made to the respective Orders, copies of which may be obtained free of charge from the Secretary, Ministry of Agriculture and Fisheries, King's Buildings, Smith Square, London, S.W.1.

Enforcement of Minimum Rates of Wages. During the month ending November 8, 1938, legal proceedings were taken against five employers for failure to pay the minimum rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases follow :—

Committee Area	Court	Fines Imposed	Costs Allowed	Arrears of Wages Ordered	No. of workers involved
		£ s d.	£ s. d.	£ s. d	
Cornwall ..	Penzance ..	(A)	—	3 10 9	1
,, ..	Stratton ..	0 10 0	—	6 11 9	1
Shropshire ..	Pontesbury..	0 10 0	0 7 6	9 0 0	1
Somerset ..	Shepton Mallet	0 10 0	2 4 0	12 0 0	1
Suffolk ..	Halesworth..	1 0 0	0 3 0	24 17 10	1
	Totals ..	2 10 0	2 14 6	56 0 4	5

(A) Dismissed under the "Probation of Offenders" Act.

PRICES OF FEEDING STUFFS

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Wheat, British ..	4 10	0 9	4 1	72	1 1	0·58	9·6
Barley, British Feeding	5 2§	0 8	4 14	71	1 4	0·71	6·2
,, Canadian No. 3 Western	5 18	0 8	5 10	71	1 7	0·85	6·2
,, American ..	5 15†	0 8	5 7	71	1 6	0·80	6·2
,, Persian .	5 5*	0 8	4 17	71	1 4	0·71	6·2
,, Russian .	6 0	0 8	5 12	71	1 7	0·85	6·2
Oats, English white .	6 7	0 9	5 18	60	2 0	1·07	7·6
,, ,, black and grey ..	6 7	0 9	5 18	60	2 0	1·07	7·6
,, Scotch, white ..	7 17*	0 9	7 8	60	2 6	1·34	7·6
,, Canadian, No. 1 feed	7 5	0 9	6 16	60	2 3	1·21	7·6
,, Canadian, mixed feed	5 18	0 9	5 19	60	1 10	0 98	7·6
Maize, American ..	6 3	0 7	5 16	78	1 6	0·80	7·6
,, Argentine ..	6 7	0 7	6 0	78	1 6	0·80	7·6
,, Benguela ..	6 7†	0 7	6 0	78	1 6	0·80	7·6
,, South African, No. 2 white Flat	6 13†	0 7	6 6	78	1 7	0·85	7·6
Beans, English, Winter	6 5§	0 17	5 8	66	1 8	0·89	19·7
Peas, English blue .	10 0§	0 15	9 5	69	2 8	1·43	18·1
,, Japanese	21 10†	0 15	20 15	69	6 0	3·21	18·1
Dari	8 0†	0 8	7 12	74	2 1	1·12	7·2
Milling Offals—							
Bran, British .	6 5	0 16	5 9	43	2 6	1·34	9 9
,, Broad	6 15	0 16	5 19	43	2 9	1·47	10 0
Middlings, fine imported	6 0	0 13	5 7	69	1 7	0·85	12·1
Weatings‡	6 0	0 14	5 6	56	1 11	1·03	10·7
,, Superfine‡	6 7	0 13	5 14	69	1 8	0·89	12·1
Pollards, imported ..	5 17	0 14	5 3	50	2 1	1·12	11·0
Meal, barley	7 2	0 8	6 14	71	1 11	1·03	6·2
,, ,, grade II	6 10	0 8	6 2	71	1 9	0·94	6·2
,, maize	6 10	0· 7	6 3	78	1 7	0·85	7·6
,, ,, germ .	6 5	0 11	5 14	84	1 4	0·71	10·3
,, locust bean	7 7	0 6	7 1	71	2 0	1·07	3·6
,, bean .. .	9 12	0 17	8 15	66	2 8	1·43	19·7
,, white fish ..	15 5	2 4	13 1	59	4 5	2·37	53·0
,, Soya bean (extracted)‡ ..	8 15	1 10	7 5	64	2 3	1·21	38·3
Maize, cooked, flaked	7 5	0 7	6 18	84	1 8	0·89	9·2
,, gluten feed ..	6 10	0 13	5 17	76	1 6	0·80	19·2
Linseed cake—							
English, 12% oil ..	10 0	1 1	8 19	74	2 5	1·29	24·6
,, 9% ,, ..	9 7	1 1	8 6	74	2 3	1·21	24·6
,, 8% ,, ..	9 2	1 1	8 1	74	2 2	1·16	24·6

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Cottonseed cake, English Egyptian seed, 4½% oil	6 0	0 18	5 2	42	2 5	1·29	17·3
Cottonseed cake, Egyptian, 4½% oil ..	5 15	0 18	4 17	42	2 4	1·25	17·3
Cottonseed cake, decorticated, 7-8% oil	7 7†	1 9	5 18	68	1 9	0·94	34·7
Cottonseed meal, decorticated, 7-8% oil	8 0†	1 9	6 11	70	1 10	0·98	36·8
Coconut cake, 5% oil	7 7	0 18	6 9	77	1 8	0·89	16·4
Ground nut cake, decorticated, 6-7% oil	8 7*	1 9	6 18	73	1 11	1·03	41·3
Ground nut cake, imported decorticated, 6-7% oil	7 5	1 9	5 16	73	1 7	0·85	41·3
Palm-kernel cake, 4½–5½% oil .. .	7 10†	0 12	6 18	73	1 11	1·03	16·9
Palm-kernel cake, meal, 5½% oil	7 12†	0 12	7 0	73	1 11	1·03	16·9
Palm-kernel meal, 1-2% oil	6 15	0 12	6 3	71	1 9	0·94	16·5
Feeding treacle ..	5 0	0 8	4 12	51	1 10	0·98	2·7
Brewers' grains, dried ale	6 2	0 11	5 11	48	2 4	1·25	12·5
Brewers' grains, dried porter . .	5 15	0 11	5 4	48	2 2	1·16	12·5
Dried sugar-beet pulp	From £5 5*s* to £5 10*s*. per ton, ex factory (according to factory)						

* At Bristol. § At Hull. † At Liverpool.

‡ In these instances manurial value, starch equivalent and protein equivalent are provisional.

NOTE: The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated and refer to the price ex mill or store. The prices were current at the beginning of November, 1938, and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative values of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, if linseed cake is offered locally at £11 per ton, then since its manurial value is £1 1*s*. per ton as shown above, the cost of food value per ton is £9 19*s*. Dividing this figure by 74, the starch equivalent of linseed cake as given in the table, the cost per unit of starch equivalent is 2*s*. 8*d*. Dividing this again by 22·4, the number of pounds of starch equivalent in one unit, the cost per lb. of starch equivalent is 1·43*d*. Similar calculations will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own markets. The figures given in the table under the heading "manurial value per ton" are calculated on the basis of the following unit prices :—N., 7*s*. 4*d*.; P_2O_5, 2*s*. 6*d*.; K_2O, 3*s*. 8*d*.

APPOINTMENTS

COUNTY AGRICULTURAL EDUCATION STAFF: ENGLAND

Buckinghamshire: Miss P. M. Kelly has been appointed Assistant Instructress in Rural Domestic Economy

Cheshire: Mr. H. J. Ward, N D H, R.H.S (Certs.), has been appointed Assistant Lecturer in Horticulture *vice* Mr P. H Brown, N D H.

Nottinghamshire: Mr. W. A Lang, B Sc (Hort), Dip Hort, has been appointed Assistant Instructor in Horticulture *vice* Mr D. V. Ingram, N D.H.

Somersetshire: Mr. A G C Powell, N D H, R H S (Certs.), has been appointed County Instructor in Horticulture *vice* Mr. R A. Engledow, N.D H.

WALES

Anglesey: Miss J. Jones, N.D D., Instructress in Dairying and Poultry-keeping, resigned

FARM VALUES OF FEEDING STUFFS

The prices in respect of the feeding stuffs used as bases of comparison for the purpose of this month's calculations are as follow :—

	Starch equivalent Per cent.	*Protein equivalent Per cent.*	*Per ton £ s.*
Barley (imported)	71	6·2	5 14
Maize	78	7·6	6 7
Decorticated ground nut cake	73	41·3	7 16
" cotton-seed cake	68	34·7	7 7

(Add 10s. per ton, in each instance, for carriage.)

The Table below is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices

FARM VALUES

Crop	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	6 10
Oats	60	7·6	5 8
Barley	71	6·2	6 4
Potatoes	18	0·8	1 10
Swedes	7	0·7	0 12
Mangolds	7	0·4	0 12
Beans	66	19·7	6 12
Good meadow hay	37	4·6	3 6
Good oat straw	20	0·9	1 14
Good clover hay	38	7·0	3 11
Vetch and oat silage	13	1·6	1 3
Barley straw	23	0·7	1 19
Wheat straw	13	0·1	1 1
Bean straw	23	1·7	2 0

In accordance with the recommendation of the Departmental Committee on Rationing of Dairy Cows, the "food values" given in the following table may be taken as applicable to the four months, December to March, inclusive, for the purposes of advisory schemes in the rationing of dairy cows.

Crop	Starch equivalent	Protein equivalent	Food value per ton, on farm
Roots—	Per cent.	Per cent	£ s.
Kohl Rabi . ..	8	0·5	0 15
Mangolds	7	0·4	0 13
Potatoes ..	18	0·8	1 14
Swedes ..	7	0·7	0 14
Turnips .	4	0·4	0 8
Green Foods—			
Cabbage, drumhead ..	7	0·9	0 14
,, open-leaved .	9	1·5	0 18
Kale, marrow stem .	9	1·3	0 18
Silage, vetch and oats	13	1·6	1 5
Hay—			
Clover hay . .	38	7·0	3 17
Lucerne hay	29	7·9	3 1
Meadow hay, poor ..	22	2·9	2 3
,, ,, good	37	4·6	3 13
,, ,, very good	48	7·8	4 16
Seeds hay ..	29	4·9	2 18
Straws—			
Barley straw	23	0·7	2 3
Bean straw .	23	1·7	2 4
Oat straw ..	20	0·9	1 18
Wheat straw .	13	0·1	1 4
Grains and seeds—			
Barley . ..	71	6·2	6 17
Beans .	66	19·7	7 0
Oats	60	7·6	5 18
Peas . .	69	18·1	7 4
Wheat . .	72	9·6	7 2

FOOT-AND-MOUTH DISEASE

The Infected Area around Benenden, Kent, referred to in the last issue of the JOURNAL, was released from restrictions on Nov. 10. On the same day outbreaks of disease were confirmed at Warfield, Berkshire, and at Bonvilston, Glamorgan, and in each case Infected Area restrictions were imposed on an area of approximately 15 miles radius round the Infected Place. The counties affected by these restrictions were respectively Berkshire, Buckingham, Hampshire, Middlesex, Oxford and Surrey, and Glamorgan and Monmouth.

Four further outbreaks have been confirmed in the area around Bonvilston, viz., at Bonvilston on Nov. 11, 17 and 20, and at Llancarfan on Nov. 15.

An Order has been issued contracting the area around Warfield to one of approximately 5 miles radius on Nov 25, and releasing the Area from restrictions on Dec. 2.

PRICES OF ARTIFICIAL MANURES

Description	Average prices per ton (2,240 lb.) during week ended Nov. 23rd.				
	Bristol	Hull	L'pool	London	Costs per Unit¶
	£ s	£ s	£ s	£ s.	s d.
Nitrate of Soda (N. 15½%) ..	8 0c	8 0c	8 0c	8 0c	10 4
,, ,, Granulated (N. 16%)	8 0c	8 0c	8 0c	8 0c	10 0
Nitro-Chalk (N. 15½%)	7 10c	7 10c	7 10c	7 10c	9 9
Sulphate of Ammonia :—					
Neutral (N. 20·6%)	7 8c	7 8c	7 8c	7 8c	7 2
Calcium Cyanamide (N. 20·6%)	7 12d	7 12d	7 12d	7 12d	7 5
Kainite (Pot. 14%) .. .	2 18	2 15	2 15	2 15	3 11
Potash Salts (Pot. 30%)	5 4	5 1	5 0	5 1	3 5
,, ,, (Pot. 20%) .	3 15	3 12	3 12	3 12	3 7
Muriate of Potash (Pot 50%)	8 10	8 8	8 5	8 8	3 4
Sulphate ,, ,, (Pot. 48%)	10 2	10 0	9 17	10 0	4 2
Basic Slag (P.A. 15¾%) .	2 12b	2 5b	.	2 10b	3 2
,, ,, (P.A. 14%) .	2 8b	2 0b	2 0b	2 6b	3 3
Grd. Rock Phosphate (P A 26–27½%)	3 4a	3 0a	2 15a	2 10a	1 10
Superphosphate (S.P.A 16%) ..	3 4		3 2f	2 19g	3 9
,, ,, (S P A 13¾%) .	3 1	..	2 19f	2 16g	4 1
Bone Meal (N. 3¾%, P.A 20½%)		7 5	7 0h	6 17	..
Steamed Bone Flour (N ¾%), P.A. 27½–29¾%) .	4 12i	4 15	4 7h	4 10	.

(* applies to the first group; § applies to the second group)

Abbreviations : N = Nitrogen P A. = Phosphoric Acid
S.P.A. = Soluble Phosphoric Acid Pot = Potash

* Prices are for not less than 6-ton lots, at purchaser's nearest railway station, unless otherwise stated. Unit values are calculated on carriage-paid prices.

§ Prices are for not less than 2-ton lots, nett cash for prompt delivery, f o.r , in town named, unless otherwise stated. Unit values are calculated on f o r. prices.

a Prices for 4-ton lots f o r Fineness 85% through standard sieve

b Prices for 6-ton lots Prices at Bristol are f o r. Bridgwater , at Hull and Liverpool f.o r. neighbouring works and at London f o r. at depots in London districts Fineness 80% through standard sieve.

c For lots of 4 tons and under 6 tons the price is 1*s*. per ton extra, for lots of 2 tons and under 4 tons, 5*s*. per ton extra, for lots of 1 ton and under 2 tons, 10*s* extra and for lots of 2 cwt. and under 1 ton, 20*s*. extra

d Delivered in 5-ton lots at purchaser's nearest railway station. For lots of 2 tons and under 5 tons the price is 5*s*. per ton extra, for lots of 1 ton and under 2 tons, 10*s*. per ton extra and for lots of 4 cwt. and under 1 ton, 20*s*. extra

f Prices shown are f o.r. Widnes.

g Prices shown are ex works London ; f.o.r. southern rails, 1*s*. 3*d*. extra.

h Prices shown are f.o r. Appley Bridge.

i Price shown is f.o.r. Newport, Mon

¶ *These are calculated by regarding a ton as comprising* 100 " *units* " (*equal parts of* 22 4 *lb.*) *so that a fertilizer, for example, with* 16 *per cent nitrogen contains* 16 *such* " *units* " *in a ton. Then, if the price per ton of such a fertilizer be divided by the percentage figure, the deduced cost is that of a* " *unit* " *of that agent. Those in the table above are based on London prices.* (*For further explanation, see Advisory Leaflet, No* 146, " *The Valuation of Artificial Manures,*" *obtainable from the Ministry, free of charge*)

WIRELESS TALKS, DECEMBER, 1938

Station and Date	*Time: p m*	*Speaker*	*Subject*
National:			
Dec 1	6 20	Mr F Rayns	Malting Barley
,, 8	6 20	Messrs. F. Rayns and A Stimpson	The Smithfield Show.
,, 15	6 20	Messrs. F. Rayns and W. D. Everington	Farming To-day. Practising my Science
,, 22	6 20	Mr F Rayns	Seasonal Talk.
,, 29	6 20	Mr. F. Rayns	Poultry
Regional:			
Dec. 31	2 0	Mr R Gamble	Bee-Keeping
Midland:			
Dec. 15	6 45		Review of Fat Stock Shows.
West:			
Dec 7	7 30	—	The Use of the Land (9): The "liberal" View.
,, 12	6 40	—	For Young Farmers.
,, 14	7 30	—	The Use of the Land (10): Right. The Self-Sufficiency View.
North:			
Dec 1	6 40	Prof J A Hanley	Bad Grass.
,, 15	6 40	Mr. James Strachan	Barley
,, 29	6 40	Mr W B. Mercer	Hens
Welsh:			
Dec 2	7 30	Messrs. W H. Jones, W Jones and D Roberts	Problems of the Smallholder in Wales
,, 9	7 30	Messrs. L Jones, W. Jones, and two farmers	The Grasslands of Wales: Manures and Seed Propagation.
,, 16	7 30	Prof R. G Stapledon, Messrs N Wilks, H Howard and B Evans	The Grasslands of Wales Trial and Error.
,, 23	7 30	Mr. W. Davies	The Grasslands of Wales

PROGRESS OF THE LAND FERTILITY SCHEME

The number of applications for contributions under the Land Fertility Scheme received from occupiers of agricultural land in the United Kingdom now exceeds 281,000. The quantities of lime and basic slag in respect of which these applications have been made are approximately 2,023,000 of lime and 541,000 tons of basic slag.

RECENT OFFICIAL PUBLICATIONS

Ordnance Survey. The Departmental Committee on the Ordnance Survey has recently presented a Final Report dealing with the scales and styles of maps which should be placed on sale to the public, and the steps which are necessary to bring the maps up to date.

The Committee recommend that the 1/2500, or so-called twenty-five-inch map, should be retained as the basic map, but that the existing arrangement should be altered, and a single series of plans, continuous over the whole country, should be substituted for the present system of a number of separate series, each continuous only over a single county or a group of small counties The Committee recommend that this change should be made as soon as practicable, and that it should be the occasion, not only for bringing all the plans up to date, but for effecting a general overhaul of the whole survey, in which any discrepancies at the boundaries of county systems, and any errors which have crept into the survey during the course of its revision, are eliminated. This rearrangement of sheets will enable all maps of every scale to be drawn on the same projection, and will make it possible to apply to all a single reference system, thus enabling any point in the country to be easily and precisely defined or identified, either on the ground or on any map This reference system depends on a grid, or network of squares, formed by lines ruled across the map at uniform and "decimal" intervals, being superimposed on all maps.

The Committee considered the steps which should be taken to accelerate the revision of the survey, and recommend that the cyclical system of revision every 20 years should be abandoned altogether and should be replaced by a so-called continuous system, whereby all changes taking place on the ground are reported to the Ordnance Survey and surveyed on the ground at the earliest possible date thereafter.

The Report also examines in detail the question of the best size and shape for the large-scale plans, and points out that the introduction of a grid will make an alteration in size essential The Committee reached the conclusion that an alteration in shape should be made at the same time as the alteration in size, and they recommend that large-scale maps should be square, the twenty-five-inch plan being exactly one square kilometre, and the six-inch sheet consisting of exactly twenty-five 1/2500 plans.

In addition to the two scales above mentioned, the Committee recommend the introduction of a new map on the scale of 1/25000, or about 2½ inches to one mile, each sheet of this map to consist of exactly four six-inch sheets, or one hundred 1/2500 plans By this arrangement of square plans, any gridded map (including the one-inch map) will be a complete index to all the large-scale plans of the area it covers

Among other recommendations in regard to matters of detail are contours at closer intervals on the six-inch map, and the omission of parcel numbers from 1/2500 plans.

The Committee gave special consideration to the use of air photography for the maintenance of Ordnance Maps. They express the opinion that air photography should prove useful, particularly in areas where there has been considerable recent building development, but they do not recommend the placing of short-term air photographic contracts with private firms, at any rate as a permanent policy. They consider that a special air survey unit or organization, working under Government control, should be brought into being as soon as practicable to carry out air photography for the Ordnance Survey. Price 5*s*. (5*s*. 3*d*. post free).

Recent Official Publications

Agricultural Statistics, 1936.—The Ministry's report constituting Part II of the annual Agricultural Statistics, Volume LXXI, has recently been published. This publication contains reports on the Census of Production enquiries relating to fruit, crops grown under glass, and milk and milk products. Other sections deal with the changes in the agricultural area, in the numbers of live stock and the trend of agricultural prices. The report also contains information as to the production and imports of agricultural commodities, and particulars relating to trade agreements and to the quantitative regulation of imports.

The tables of prices and index numbers formerly appearing in Part II have already been published in Part I of Volume LXXI, but the tables of imports appear, as hitherto, in Part II. Price 2*s*. 6*d*. (2*s*. 8*d*. post free).

SOME ADDITIONS TO THE LIBRARY

Agriculture, General and Miscellaneous

Ernle, Lord—Whippingham to Westminster. The Reminiscences of Lord Ernle (Rowland Prothero). (xx + 327 pp. + 8 plates.) London: John Murray, 1938, 18*s*.

Robinson, D. H.—The New Farming (180 pp. + 12 plates) London: Nelson & Sons, 1938, 2*s*

Darby, H. C. (Editor)—The Cambridge Region. (xii + 234 pp.) Cambridge at the University Press, 1938, 6*s*.

Porteous, C.—Farmer's Creed. (278 pp) London: G. Harrap & Co, 1938, 8*s* 6*d*

Branton, J. H.—Vital Agriculture in Great Britain, Denmark and the Argentine. (86 pp) Bedford: Rush & Warwick, 1938, 2*s*. 6*d*.

Wood, W.—A Sussex Farmer. (223 pp) London: Jonathan Cape, 1938, 8*s*. 6*d*.

Nixon, H. C.—Forty Acres and Steel Mules (vii + 98 pp.) Chapel Hill: The University of North Carolina Press; London: Oxford University Press, 1938, 11*s* 6*d*.

Herrod-Hempsall, W.—The Bee-keeper's Guide (169 + ix pp. + 1 plate.) London. British Bee Journal, 1938, 2*s*. 6*d*.

Hegner, R., Root, F. M., Augustine, D. L., and Kuff C. G.—Parasitology. (xxi + 812 pp.) New York and London Appleton-Century Co., 1938, 25*s*.

"*Fish-Hawk*" (*Murray, D. K. W.*).—Birds Through the Year. (96 pp. + 38 plates) London. Duckworth, 1938, 10*s*. 6*d*.

Brunt, D.—Weather Science for Everybody (xii + 170 pp) London: Watts & Co, 1936, 2*s*. 6*d*.

International Labour Office.—Studies and Reports: Series B. (Economic Conditions). No 30: The Worker's Standard of Living. (101 pp.) London P. S. King & Son, 1938, 2*s*.

Claxton, W. J.—The Homeland Histories, Books I–VI. London: Wells, Gardner, Darton & Co., Ltd., 1938, 1*s* 9*d*. each vol.

1. Our Homeland in the Dark Ages.
2. Saxon and Norman Days.
3. The Middle Ages
4. Tudor and Stuart Periods.
5. The Agrarian Revolution.
6. The Age of Science.

Department of Scientific and Industrial Research.—Index to the Literature of Food Investigation. Vol. 9, No. 4. London: H.M. Stationery Office, 1938, 4*s*. 6*d*.

Some Additions to the Library

Agricultural Economics

Ministry of Agriculture and Fisheries.—Index Number of Agricultural Prices. (41 pp.) London: H.M. Stationery Office, 1938, 9*d.*

Schultz, H.—The Theory and Measurement of Demand. (xxvi + 817 pp.) Chicago: University of Chicago Press; London: Cambridge University Press, 1938. 34*s.*

Imperial Economic Committee.—Supplies of Canned and Dried Fruit, 1937. (Supplement to Canned and Dried Fruit Notes.) London: H.M. Stationery Office, 1938, 2*s.* 6*d.*

Agricultural Machinery

Jones, F. R.—Farm Gas Engines and Tractors. (2nd Edition.) (xii + 486 pp.) London and New York: McGraw-Hill Publishing Co., 1938, 21*s.*

Jasny, N.—Research Methods on Farm Use of Tractors. (xxvi + 273 pp.) New York: Columbia University Press; London: Humphrey Milford, 1938, 18*s.* 6*d.*

Botany and Plant Physiology

Bracher, R.—Field Studies in Ecology. (100 pp.) Bristol and London: J. W. Arrowsmith, 1934, reprinted 1936, 2*s.* 6*d.*

Bracher, R.—Ecology in Town and Classroom. (96 pp.). Bristol and London: J. W. Arrowsmith, 1937, 2*s.* 6*d*

Nicol, H.—Plant Growth Substances. (xii + 108 pp.) London: Leonard Hill, 1938, 3*s* 6*d.*

Fritsch, F. E., and Salisbury, E. J.—Plant Form and Function. (xiii + 668 pp) London. G. Bell & Sons, 1938, 17*s.* 6*d.*

Hooker, J. D.—The Student's Flora of the British Islands (xxxii + 563 pp.) London: MacMillan & Co, 1937, 10*s.* 6*d.*

Thomas, J. O, and Davies, L. J.—Common British Grasses and Legumes. (124 pp) London: Longmans, Green & Co, 6*s.*

Smith. G.—An Introduction to Industrial Mycology. (xii + 302 pp.) London: Edward Arnold & Co., 1938, 16*s*

Crops

Peel, W. R.—Grassland Management for the Practical Farmer. (xv + 191 pp.) London: Macmillan & Co., 1938, 7*s.* 6*d.*

Brown, H. B—Cotton; History, Species, Varieties, Morphology, Breeding, Culture, Diseases, Marketing and Uses. (2nd Edition) (xii + 592 pp. + 1 plate.) New York and London: McGraw-Hill Publishing Co., 1938, 30*s.*

Dairying and Dairy Products

Hammer, B. W.—Dairy Bacteriology. (2nd Edition.) (xiv + 482 pp.) New York: John Wiley & Sons; London: Chapman & Hall, 1938, 25*s.*

National Institute for Research in Dairying (University of Reading) and the Rowett Research Institute, Bucksburn, Aberdeen.—Milk and Nutrition. New Experiments Reported to the Milk Nutrition Committee. Part III. The Effect of Commercial Pasteurisation on the Nutritive Value of Milk as Determined by Experiments on Calves. (27 pp. + 4 tables.) Reading, 1938, 2*s.*

Fruit Culture

Shewell-Cooper, W. E.—Up-to-Date Fruit Growing. (296 pp. + 8 plates) London: The English Universities Press, 1938, 8*s*. 6*d*.

Seabrook, W. P.—Modern Fruit Growing. (5th Edition.) (xi + 327 pp.) London: Ernest Benn, 1936, 7*s*. 6*d*.

Livestock and Poultry

Livestock Commission.—First Report for the period August 1, 1937, to March 31, 1938. (iv + 53 pp.) London: H.M. Stationery Office, 1938, 1*s*.

Virtanen, A. I.—Cattle Fodder and Human Nutrition. (108 pp. + 8 plates.) Cambridge at the University Press, 1938, 7*s*. 6*d*.

Woodgate, W. F.—The Complete Book of the Rabbit. (125 pp. + 3 plates.) Idle, Bradford and London Watmoughs, 1937, 2*s*. 6*d*.

Newman, T.—Principles and Practice of Poultry Husbandry. (188 pp. + 23 plates.) London: The English Universities Press, 1938, 5*s*.

National Association of Marketing Officials.—Egg Legislation and Grades in the United States. (253 pp. mimeo. + 3 plates.) Connecticut Department of Agriculture, 1935.

Soils and Fertilisers

Imperial Bureau of Soil Science.—Technical Communication No. 37: Soil Structure, by *E. W Russell.* (40 pp.) Harpenden, 1938, 2*s*.

Waksman, S. A.—Humus: Origin, Chemical Composition, and Importance in Nature. (2nd Edition.) (526 pp) London: Baillière, Tindall & Cox, 1938, 30*s*.

NOTICES OF BOOKS

British Agriculture: the Principles of Future Policy. A Report of an enquiry organized by Viscount Astor and B. Seebohm Rowntree. PP. xx + 469. (London: Longmans. 1938. Price 15*s*.)

Subsequently to the publication of their *Agricultural Dilemma* in 1935, Lord Astor and Mr. Seebohm Rowntree have been extending their enquiries into the problems of British agriculture. The study group which previously assisted them has been kept in being: they have also taken counsel from a numerous company of experts, and they have clearly been at great pains to make their investigation as complete as possible. The result of these labours is the book before us. The actual drafting of the book was entrusted to Mr. H. D. Henderson, who, as would be expected, has produced a volume which is thoroughly readable throughout, and in which the discussion is maintained on a very high plane. Indeed, it would be true to say that no book on agriculture which has appeared in recent years has offered a survey of British agriculture with the sweep and range which are here presented. As its title indicates, the purpose of the book is to consider British agriculture in relation to policy, and to this end the "report" begins with a discussion of the objectives of agricultural policy, and these are considered in relation to the changing structure of British agriculture in the period 1866–1938. A detailed study follows of the principal crops and live-stock products, together with an examination of the working of the various marketing schemes, and the "report" concludes with a survey of problems related to personnel and organisation, e.g., the agricultural worker, the small holder, the tenant farmer and the landlord, as well as a survey of agricultural credit and the facilities available in regard to agricultural education and research.

It would obviously be quite impracticable within the compass of the short review which our space allows, to do justice to this book by way of a detailed examination of so comprehensive a survey, nor is this the place for such an examination. It may, therefore, suffice to say that the "report" proceeds from the point of view that while a return to the old free-trade policy which prevailed prior to 1931 cannot be contemplated as a practical measure at the present time, it would be a mistake to advocate an expansion of British agriculture by further protection or by subsidies on commodities which can be more cheaply or efficiently produced abroad. A "happy marriage between nutrition and agriculture" which does not depend merely on shutting out all overseas competition is the direction in which it is suggested that agricultural policy should advance The "report" argues that about the same degree of assistance should be accorded to agriculture as at present, although some modification of existing arrangements as well as some important changes in the constitution of the Marketing Boards are thought to be necessary.

The Open Fields. By C S. and C. S. Orwin. Pp. lii + 332. Illus. (Oxford: Clarendon Press. 1938. Price 21*s*.)

In this work it is argued that the origin of the open fields was based in the necessities of farming technique rather than in social or constitutional organization Few would be inclined to join issue with the authors on their main thesis which is put forward in a most convincing manner, but there are some points of detail on which further and more definite information is required. For instance, the suggestion that the lowlands were inhabited in pre-historic times, as well as the downland where the evidence of occupation is unmistakable, is highly controversial. Minor matters such as this do not change the general character of the book which has thrown out most valuable suggestions that no historian of agriculture can afford to neglect.

The general reader will perhaps be more interested in the story of Laxton itself than in the academic arguments which precede it. The wealth of documents from which the evidence is drawn is unusual and probably unique, and the story based upon them is presented in the pleasant style that has come to be associated with the name of the authors.

The book concludes with a reprint in full of the Survey of Laxton made in 1635 which will be invaluable to historians. Few enough documents have been printed in full and when one of such importance as this is reproduced the historian can only be thankful.

The illustrations and maps are illuminating and help the argument. Both will be of service to the lay reader and to the historian. Indeed this work makes the best of both worlds and should have a wide appeal to the general public and to the academic reader.

Famine in England. By Viscount Lymington. Pp. 271. (London: H. F. & G Witherby. 1938. Price 7*s*. 6*d*.).

This is a spirited plea for the regeneration of agriculture, intensely critical and provocative but full of constructive suggestions and ideas. It is based on observation and experience and is written with such a deep sense of conviction that one can overlook the exuberance, not to say, extravagance, of occasional purple patches. The underlying idea is the land as a basis of a sound national policy, social as well as agricultural. Without ample food reserves and a full use of the land the author foresees

famine and revolution in the event of war. He cites the widespread erosion and waste of land which have resulted from opportunist methods of husbandry practised in countries from which we have been accustomed to draw much of our food supplies and emphasises the importance of a long view in any attempts to re-establish agriculture at home. The health of the soil is the first essential for a sound agricultural policy which would also take account of the health of the people. The author is probably not far wrong in maintaining that modern scientific " progress " has been directed to quantity rather than quality—but he is on doubtful ground when he argues that food produced by the help of chemical fertilizers is inferior to that grown with the aid of organic manure. It is, however, true that a well-stocked farm with an increased oat and root acreage would mean comparatively little expense for bought foods and manures.

It is, of course, realized that a return to greater diversification and intensification of agriculture means more labour on the land. The problem is one of statesmanship and courage, of balanced values in national life. If there is to be justice, health and safety in national life, says the author, the land labour should not be grudged a right reward even if it means putting up the cost of food so that it may become level with other necessities such as housing, clothes and transport

Readers may agree or disagree with the views of this lively writer. Few will relinquish his book till they have read it from cover to cover.

Farmer's Creed By Crichton Porteous (London George G. Harrap & Co., Ltd. 1938 Price 8*s* 6*d*.)

In spite of the continuous drift of labour from agriculture to other industries, there will always be some men in the towns who cannot resist the lure of the land. This book describes how the author when a youth of 19, after spending three years in his uncle's office in Manchester, gave up the chance of inheriting his uncle's business, which had produced a fortune of £250,000 from nothing out of cotton, and went to work as a farm labourer because he believed that mere money-making was not worth while, and that life was unsatisfactory unless one worked with one's hands in the open air and produced something useful for other people That is the author's creed. So he took a job on a farm in Cheshire, which proved to be badly managed

Six months later he moved on to a hill farm in the Peak District, where he found almost complete happiness in useful manual work. His new employer, Mr. Boone, was a competent working-farmer whose relations with his men were perfect, and there was a spirit of friendliness and kindly co-operation about the place in marked contrast to the unkindliness of nature on those bleak uplands. Mr Boone's Bible was Ruskin's " Unto this Last," and his creed could be summed up in the one word—work. This creed was put into practice on the farm, where everybody worked hard and cheerfully. Not only did it pay ; Mr. Boone was able to buy four contiguous farms as he prospered, although he had started by selling horse manure off the road at 6*d*. a barrow, and 30 years of his life had been spent as a railway clerk.

This is a very readable book. If, as a true story, it is in places somewhat difficult to believe, no doubt that is because truth must concede something to literary art. The author is at his best when describing the beauties of the English countryside. Those of his readers who are thrilled by these descriptions and who hold to the creed, will be disappointed to find that he soon deserted the plough for the pen. They would like to have pictured him at the present time, in his 39th year, as a younger Mr. Boone, farming on his own account. Alas ! he drifted back to Manchester, and spent ten of the best years of his life in a newspaper office.

Notices of Books

Soilless Growth of Plants. By Carleton Ellis and Miller W. Swaney. Pp. 155. (New York: Reinhold Publishing Co. Price 13*s*. 6*d*.)

The interest which has been aroused in recent years at the possibility of the successful growth of plants in so-called soilless conditions finds expression in this little book by two American authors who have been engaged in experimental work in this type of culture for some years past. The subject is dealt with briefly but at the same time all the important aspects seem to be covered. After a discussion of the chemistry of plant life, the authors go on to describe the requirements of growing in mineral aggregates; the water culture system; and the arrangements which can be made for the culture of flowers and vegetables on this system in the household Dealing with the commercial possibilities of this system of culture, the authors are cautious, but they do envisage a considerable extension of its use in connexion with glasshouse work for which a number of advantages are claimed The book, which is well printed and generously illustrated, concludes with chapters on special chemicals and on nutrient formulae. It should form a useful and readable introduction to the subject.

An Introduction to Industrial Mycology. By G. Smith. Pp. xii+302, and 127 Figs. (London: E. Arnold & Co. 1938. Price 16*s*.)

This book is the best introduction to the subject of industrial mycology, including both laboratory methods and preliminary identification work, that exists at present in English. The book is abundantly illustrated with photomicrographs of many of the common species of moulds, those of the *Penicillia* especially revealing that the author is an accomplished technician. Throughout the book one feels that the author has had much practical experience with the fungi that he describes

Following two introductory chapters, come six on classification, with descriptions of the commoner species of moulds. *Aspergillus* and *Penicillium* species are dealt with specially in chapters of 47 pages each. Then follow chapters on laboratory equipment and technique, physiology of mould fungi, maintenance of a culture collection, control of mould growth, industrial uses of fungi and mycological literature.

Manual of Cultivated Plants. By L. H. Bailey. Pp 851. (London Macmillan & Co, Ltd. 1938 Price 21*s*)

This edition of Prof. Bailey's well-known Manual is an exact reprint of the first edition, issued in 1924, but the price has been reduced from one and a half to one guinea. In his introduction the author says that "the purpose of this book is to provide a ready means for the identification of the species in the usual domestic flora of the continental United States and Canada" When first published, the Manual was the only book covering the same field, and this is still true 14 years afterwards. Though written for American readers, a large number of the plants described are grown in this country and the volume is a mine of information on the systematics of British cultivated plants

In addition to the systematic enumeration of families, genera and species, which is arranged on Engler's System and contains keys to all groups, there are sections on herbarium technique, botanical terms and names, and authorities, and a single index of Latin and English names.

Up-to-Date Fruit Growing. By W. E. Shewell-Cooper. Pp. 296. Illus. (London: The English Universities Press, Ltd. 1938. Price 8*s*. 6*d*.)

This is an attractively produced book by Mr. W. E. Shewell-Cooper on *Up-to-Date Fruit Growing*, written for the beginner. The different classes of fruit are dealt with, cultural problems briefly discussed, and the book contains chapters on fruit pests and diseases and their control.

Science in Agriculture. By J. W. Paterson. Pp. viii + 288. Illus. (London: Longmans, Green & Co., Ltd. 1938. Price 6*s*. 6*d*.)

This little book is intended to take its place among the books available to the science form of secondary schools. It aims at explaining the scientific principles which are involved in the growing of crops and in the feeding of stock. To have accomplished this programme in a small book of less than 300 pages may be regarded as a considerable achievement. Unassisted, the young student would probably find the material rather too compressed, but as the basis of form lessons the book should serve a useful purpose It is quite clear that if a schoolboy is taken carefully through this book with a capable science master to give the chapters where required some verbal expansion or additional illustration, his understanding of agriculture and the agricultural processes will be a most welcome advance on what is usual in boys coming from the secondary schools And as the author says in his preface there is no reason why students at our secondary schools or colleges should not receive their mental training from the study of agricultural science. The book is well illustrated and is produced in a handy format.

British Rainfall, 1937. Pp. xx + 293 (London. His Majesty's Stationery Office. 1938. Price 15*s*.)

This publication of the Meteorological Office is the seventy-seventh annual volume of the British Rainfall Organization. It contains a mass of information compiled from the rainfall records for 1937 from 5,571 private and public "stations" in the United Kingdom and Eire. Descriptive matter, tables and maps are included, and make a comprehensive picture of all aspects of the actual rainfall of these islands during 1937 Data on "rain-days" (days on which 0.01 in. or more were recorded), "wet-days" (0·04 in or more), partial and complete droughts, wet and dry spells, etc, throw interesting light on the distribution and duration of the country's rainfall. It is not without interest to record that the largest daily amounts of rain occurred on St. Swithin's day, July 15, and intense falls in short periods were most numerous on that day. Over the British Isles as a whole the rainfall of 1937 was above the average; England and Wales giving a figure of 110 per cent of the average, and Ireland (Northern Ireland and Eire) 103 per cent. On the other hand, less than the average was recorded in Scotland The volume is completed by some general articles on rainfall in Great Britain

Principles of Soil Science. By A. J. de Sigmond, Ph D. Translated from the Hungarian by A. B. Yolland, B A Cantab., Ph D. Pp. xiv + 362. (London: T. Murby & Co. 1938 Price 22*s*. 6*d*)

Professor de Sigmond's book *Altalanos Talajtan* is here reproduced in somewhat shortened form for English-speaking readers under the title of the "Principles of Soil Science." The book aims at a comprehensive survey of pedology, but, as Sir John Russell says in his foreword to this volume, the main theme of the book may be taken to be the presentation and discussion of the system of soil classification already known internationally by the author's name but never before described in detail in an English publication. It is not necessary here to enter into the technicalities of this difficult subject; it suffices to say that if not final, Professor de Sigmond's work does take us a considerable step farther towards that desirable end—a universal soil classification based on strictly scientific principles.

This book is naturally for the advanced student or research worker. Despite the technicalities of the subject, however, the author and his collaborators have succeeded in producing a work which is very readable and clearly written. A meed of praise is due to the publishers for an admirably printed and turned-out volume.

Notices of Books

Special Pathology and Therapeutics of the Diseases of Domestic Animals. By Hutyra, Marek and Manninger. 4th English edition, edited by by J. Russell Greig, Ph.D., M.R.C.V.S., F.R.S.E., with the collaboration of John R. Mohler, D.V M., D Sc., and Adolf Eichorn, D.V.S. 3 vols. Pp 2410. 724 illustrations. (London. Baillière, Tindall & Cox. 1938. Price £6 6*s*.)

This work is now regarded as the standard text-book of veterinary medicine in Great Britain, America and many Continental countries. Originally written in German, early recognition of its value was marked by translation into English. The sixth German edition is now in course of preparation, but the demand for the work in English necessitated publication of this new edition, the fourth, without awaiting the German issue The appearance of Manninger's name as author is due to the death of Hutyra, whose pupil he was. With American and English editors, the book is truly international

The extraordinary expansion of knowledge in every department of veterinary medicine has called for fundamental revision of and addition to the text. Specialists in the various branches will find that it has failed to keep pace with developments but it is a monument of patient and accurate compilation. The expressed design of meeting the needs of research workers in comparative pathology and of practicing veterinary surgeons has been attained Many of the illustrations are obscure and outmoded The technical phraseology renders the text unsuitable for the lay reader. The publisher's task is well done

The Feeding and Management of Pigs for Pork and Bacon. By Charles Crowther, M.A, Ph D. Pp. 40. (Newport, Shropshire Harper Adams Agricultural College. 1937 Price 1*s*)

The work of the author as Director of the Pig Feeding Experimental Station at the Harper Adams Agricultural College is widely known and recognized He has succeeded in covering the entire range of pig management in this booklet of forty pages written in language which the farmer can readily understand, and from a view point which the practical man will appreciate and call " common-sense." The booklet contains information on the housing, breeding, feeding, management and common ailments of the pig. The food requirements of the pig at all stages are explained and illustrated by typical rations A classification of all the common feeding stuffs is given, and a simple system of compounding rations which enables full advantage to be taken of fluctuations in market prices.

Ducks. By R. Appleyard. Pp. 156. Illustrated (London: Poultry World, Ltd. 1937. Price 4*s*.)

Mr. Reginald Appleyard has had many years of practical experience in the breeding and keeping of ducks, and in his latest book, " Ducks," he reviews many of the breeds of duck kept in this country for both commercial production and for ornamental purposes. The author stresses one of the greatest points in favour of duck keeping, one that is especially attractive to new recruits to the industry, namely that ducks are comparatively free from disease.

The book deals with the many and various phases of duck keeping, which includes the housing, management, feeding, breeding and selection, and rearing. A short chapter is devoted to the summarizing of many important points about ducks, which is of special use to the beginner in avoiding the numerous pitfalls. This publication is attractively printed, and contains many good illustrations of the various breeds, and should be a useful addition to the duck keeper's bookshelf.

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NOTES FOR THE MONTH

Barley Subsidy

In reply to a question in the House of Commons on December 9, the Minister of Agriculture made the following statement:—

"The Government have been impressed with the serious situation which has resulted from the abnormal decline in prices of barley, particularly malting barley, and have summoned a conference of growers, brewers, maltsters and other users of barley, including merchants, to consider methods of preventing the recurrence of these conditions. It is recognized that any proposals which may be put forward by the conference can relate only to future seasons. So far as this season is concerned the Government, as an emergency measure of assistance to those farmers who are dependent on barley, propose to invite Parliament to increase from the present estimated figure of 10s. per acre to £1 per acre the subsidy payable to barley growers under the Agriculture Act in respect of this year's crop.

"Opportunity will be given to all growers of barley who have not hitherto applied for subsidy under that Act to do so, and to those who have elected for this season to take wheat deficiency payments under the Wheat Act, to reconsider their decision and, if they so desire, now to elect for subsidy under the Agriculture Act.

"As regards feeding barley and oats, the Government propose to review the degree of assistance afforded to those cereals under the Agriculture Act, 1937."

Mutton and Lamb

In reply to a question in the House of Commons on December 20, the Minister of Agriculture made the following statement:—

"The Government have had under constant review

during the current year the situation of the home sheep industry. A number of factors, other than the influence of imported supplies, have operated during 1938 to depress the prices realised for home-produced sheep and lambs; and a return to more normal conditions, including an improvement in the price of wool and of the bye-products of the slaughter of sheep, would help to restore prices to more satisfactory levels. It is considered, however, that this recovery would be accelerated by a closer control of imported supplies. This would be in the interests of all suppliers and would introduce a very desirable element of confidence into the sheep market. In view of the large proportion of the supplies which comes from Australia and New Zealand, approaches have been made to the Governments of those Dominions with a view to the adoption of further measures to regulate imports of mutton and lamb to the United Kingdom market as from the beginning of 1939. As the House is aware, imports of beef and veal are already dealt with by means of consultation between representatives of the countries mainly concerned, and I am very glad to be able to announce that, following this precedent, and after considering the replies from the two Dominions mainly affected, it has been decided to enlarge the functions of the Empire Beef Council so that it may in future also consider supplies of mutton and lamb to the United Kingdom market. While the Council would consider the supply situation as a whole, the United Kingdom Government would reserve to itself responsibility in regard to the regulation of imports from foreign countries.

"It is intended, in order to ensure that effect is given to the Council's conclusions and to continue the regulation of imports from foreign countries, to issue an Order at an early date under the Livestock Industry Act, 1937, by which all imports of live sheep, mutton and lamb into the United Kingdom will, in future, be subject to licence. The licensing system will be such as to ensure that imports within the quantities recommended from time to time by the Council are freely admitted. Special provision will be made for imports for which shipping space has already been booked. The application of the proposed system to imports from Eire is under discussion with representatives of that country. No interference with the normal course of the trade is contemplated pending consideration by the Council. It is

intended that the Order should come into operation on January 15, 1939. Opportunity will be provided for the discussion of the Order by both Houses of Parliament, in accordance with the terms of the Livestock Industry Act, shortly after the Christmas Recess."

In reply to a supplementary question, the Minister said that it was not at present the intention to include foreign countries on the proposed Council but that His Majesty's Government did not consider such an arrangement to be ruled out as an eventual possibility.

The Land Fertility Committee

In their First Report,* covering the first nine months of the Scheme, the Land Fertility Committee claim that the Land Fertility Scheme was successfully launched with the goodwill of all the interests concerned. Some 207,000 applications for contribution were received from 140,000 farmers, who had used 1,395,000 tons of lime and 409,000 tons of basic slag. These figures are equivalent to a fourfold increase in the quantity of lime, and a 70 per cent. increase in the quantity of basic slag, used before the advent of the Scheme.

The most recent figures up to December 3, 1938, show that the number of applications received was 303,000, representing 2,193,000 tons of lime and 585,000 tons of basic slag, the total amount paid in contribution being £1,526,000.

The counties which have used most lime are Yorkshire (115,000 tons), Lancashire (85,000 tons), Essex (66,000 tons), Cornwall (60,000 tons) and Suffolk (56,000 tons). The counties which have used most basic slag are Devon (29,000 tons), Yorkshire (26,000 tons), Northumberland (18,000 tons), Lincolnshire (17,000 tons) and Shropshire (16,000 tons).

With the exception of farmers in Cornwall, Devon and the Orkneys, who made full use of local sources of sea sand, and of farmers in Norfolk who obtained substantial supplies of lime in the form of marl and dug chalk, farmers generally have been slow to take advantage of paragraph 7 of the Scheme, which enables them to apply for contribution on lime procured by their own labours from local sources. A considerable saving of money by farmers would result from an increased use of this part of the Scheme. The Report reprints in an Appendix the detailed procedure that must be followed before

* Published by H.M. Stationery Office, price 6*d*.

applying for contribution on lime so procured, the most important point to observe being that operations must not start until the Committee's approval has been obtained. Failure to observe this condition can only result in disallowance as the Committee have no power to waive this requirement.

Some 500 Associations of small farmers and allotment holders also claimed collective contributions on behalf of their members, who individually were unable to use as much as two tons, the minimum quantity recognized by the Scheme. The procedure for obtaining recognition as an "Approved Association" and the standard measure of maximum rates for road transport, on which the Committee's checking staff are working, are also set out in detail in Appendices to the Report.

The Committee emphasize the importance of farmers checking the quality of lime and slag supplied to them by having samples tested under the Fertilisers and Feeding Stuffs Act, 1926. The Committee themselves have arranged for samples to be taken periodically at producers' premises.

The Land Fertility (Research) Fund, which is derived from the "twopences" deducted from farmers' contributions and from similar amounts collected from lime producers, will, it is estimated, amount to approximately £18,000 a year. The Fund is being used by Ministers mainly to defray the cost of additional staff at the Provincial Advisory Centres in order (1) to ensure that any farmer can have soil samples tested free of charge, and without delay, and (2) to undertake, in consultation with the Agricultural Organizer, surveys of selected areas chosen in the light of local experience as being most likely to reveal deficiencies of lime or phosphate, with a view to co-ordinating, at a later date, all the information in a comprehensive survey.

FROST AND FRUIT-GROWING

C. E. CORNFORD,
East Malling Research Station, Kent

Late in the blossoming season of 1935 there occurred cold north winds and a very severe frost which caused great damage to fruit trees in many parts of Europe. East Malling Research Station made a field survey of the damage done to fruit trees in Kent and neighbouring counties and arrangements were subsequently made which have enabled research work on the problem of the incidence of frost to be continued. The following article gives a brief account of this work, and indicates some practical conclusions.

The most common type of frost, called a radiation frost, to distinguish it from a wind-frost, can occur only at night when the air is calm and when the sky is free from cloud. Under these conditions there is nothing to prevent the heat in the ground and trees passing by radiation into inter-stellar space.

In this climate, radiation frosts can occur only at night because during the day the quantity of heat received from the sun is greater than the quantity lost by radiation. This causes the ground and trees to become warmer. During the night, however, the ground and trees receive very little heat compared with what they lose under a clear, calm sky, and their temperature falls. It usually falls most rapidly just at sunset, and as the night proceeds it falls less quickly. The lowest temperature is usually reached at dawn. As soon as the sun becomes visible at dawn the temperature of the ground and trees rises rapidly.

Low clouds can prevent the soil and trees from losing heat by radiation, because heat waves cannot pass through them. Low clouds act better as blankets to the earth than high clouds; and the highest clouds, which are composed of ice particles, have no blanket effect.

A radiation frost can occur only in calm or slowly-moving air because a strong wind tends to mix the cold and warm air layers which are formed in a radiation frost. The specific gravity of cold air is higher than that of warmer air. Therefore, when cold and warm air masses are free to move in an orchard, the cold air sinks as close to the ground as possible, and the warm air forms a layer above it.

This explains why the tops of tall trees are often not damaged by frost while their lower branches may be severely

damaged. This effect was well seen on the Sussex Weald this spring (1938), when nearly all trees, except the tops of tall oaks, were deblossomed and defoliated. The writer measured the height to which many of the oaks were damaged and found that in sloping fields the level of damage tended to follow the contours. For example, trees standing at 150 ft. above sea level were damaged to a height of 30 ft., while those standing on much lower ground, at 100 ft. above sea level, were damaged to a height of only 40 ft.

The height above the ground of the lower surface of the warm layer varies widely from night to night. When it is low enough to protect the tops of tall trees from frost, orchard heaters have their best chance to heat the orchard air, because they do not have to heat up all the atmosphere, but only the cold layer which is sandwiched between the ground and the warm layer. The warm layer is called the "ceiling," and it is easy to understand that, when the ceiling is high, say at 2,000 ft., orchard heaters have an almost impossible task to perform in trying to heat up such a deep layer of cold air.

For similar reasons, propeller methods of frost prevention which have been used for a number of years in California, should work best when the ceiling is low.

On a sloping piece of ground the layer of cold air tends to move downhill, and creates a gentle wind, called a katabatic wind. Katabatic means down-going. Katabatic winds are most readily found on the lower part of sheltered hillsides. They may cause large amounts of relatively cold air to accumulate on low-lying ground in a radiation night. When the temperature of this air falls below the freezing point of water we say there has been a frost, and because the heat was lost by radiation it is called a radiation frost. In view of these generally accepted facts it was thought advisable to begin this investigation with a study of the katabatic winds.

Katabatic Winds. Owing to the fact that the katabatic winds in Kent move at comparatively slow speeds, specially sensitive instruments for recording their speed and direction, the vanes of which were at a height of one and a half feet above the ground have been devised.*

Katabatic winds were first studied on a steep slope (1 in 3) on the Kent North Downs, facing S.S.W. It was found that

* A more detailed account of this work has been published in the Quarterly Journal of the Royal Meteorological Society, Vol. 64, No. 277, October, 1938.

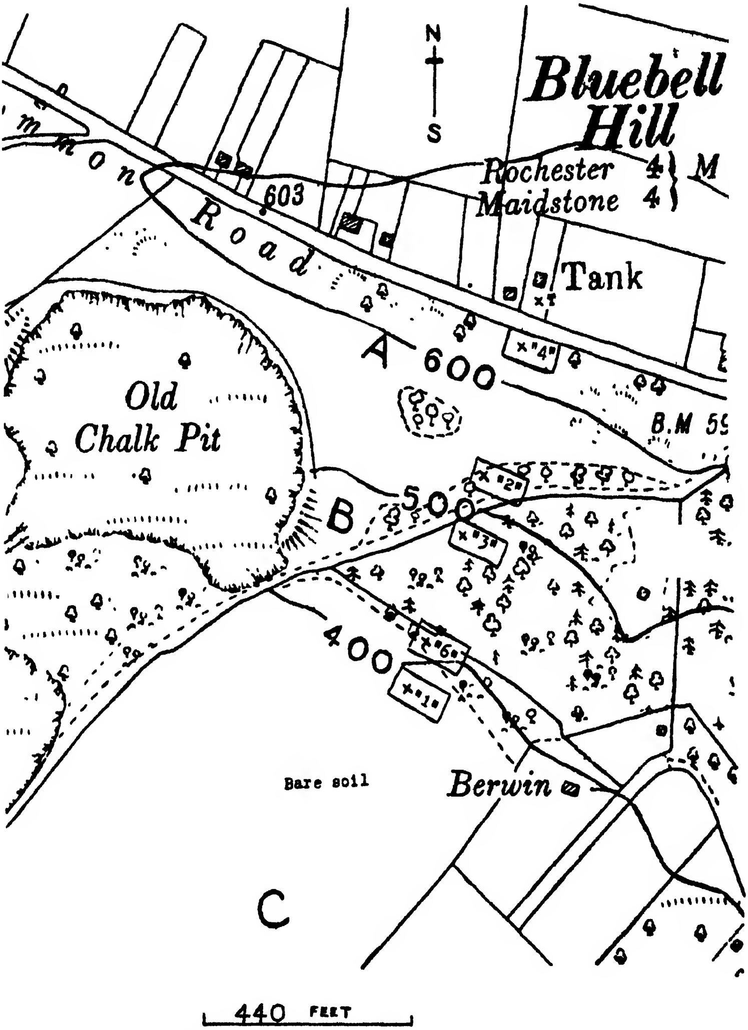

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FIG. 1.—Contour Map of the 1 : 3 slope at Bluebell Hill.

on most radiation nights, a relatively strong and warm wind was blowing on the hilltop, at point A (Fig. 1). This wind, called for convenience the "hilltop" wind, usually blew from the same direction as the wind that had been blowing during the day, but was much weaker than the day wind. When the

hilltop wind blew from the S.S.W. upon this slope, it was observed that as the slope was descended the force of the hilltop wind grew less, until a zone was found where the air was still, at point B (Fig. 1). Below this, a katabatic wind was found flowing down the hill at about 2 or 3 miles per hour. Therefore, above the still zone the air moved uphill, below it the air moved downhill. The position of the still zone varied as the hilltop wind varied in strength, and was highest when the hilltop wind was weakest. The still zone has been given the special name of "neutral zone," because it forms where the hilltop wind and katabatic wind blow with equal force in opposite directions, and thus neutralize one another. These air movements are shown in Fig. 2.

When the hilltop wind blew slantwise on the slope the

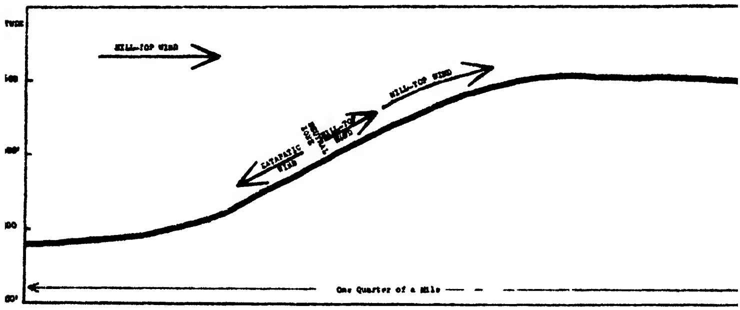

Fig 2—A section, drawn to scale, through Bluebell Hill, showing typical air movements on a radiation night when the hill-top wind blows directly upon the slope Note the katabatic wind on the lower part of the slope, the uphill wind on the upper part of the slope, and the neutral zone of calm air between

katabatic wind moved at first slantwise downhill, then straight downhill, and a place could always be found on the slope between the hilltop wind and the katabatic wind, where the air moved straight along the contours.

Observations made with recording anemometers placed at points 4, 2, 3, 6 and 1 (Fig. 1) have shown that, in a wood on the North Downs, the air movements were the same as on a grass-covered slope. In the upper part of the wood the wind blew uphill, and in the lower part of the wood the wind blew downhill; between these two winds blowing in opposite directions, there was a neutral zone in which the air, although not quite still, moved in no definite direction. A similar experiment made in Hampshire gave a similar result, indicating that forest trees and shrubs offer little obstruction

to a katabatic wind. If the smoke of a bonfire passing through a windbreak or narrow strip of tall wood, in fairly calm weather, be attentively examined, it will be seen that the vegetation offers little resistance to the motion of low-speed winds. Other observations showed that a well-kept beech hedge, 7 ft. high with flat sides, at right angles to the direction of a katabatic wind, caused the wind to flow over instead of through the hedge. A wall was found to have the same effect, as shown in Fig. 3, indicating that it is difficult to nullify the harmful effect of a katabatic wind by attempting to alter its course. As shown below, it appears easier to alter its temperature.

On a slope facing the hilltop wind the katabatic wind and hilltop wind blow in contrary directions, making it easy to recognize the katabatic wind simply on the evidence of its direction. For this reason, most of this work has been done on slopes facing the hilltop wind. On a radiation night in March, 1937, when katabatic winds were blowing on the lower parts of slopes facing the north hilltop wind, air currents were investigated on the leeward side of a steep slope facing south (North Downs). It was found by releasing smoke that the air to a depth of several hundred feet at the foot of the steepest part of the slope (Fig. 1, point C) was exceptionally calm. The probable explanation is that an eddy is formed in the lee of the hill by the hilltop wind. The " return " current of this eddy, tending to blow uphill, and the katabatic wind, tending to blow downhill, counterbalanced one another, producing the calm.

Temperature. The temperature of katabatic and hilltop winds has been studied by means of screened minimum thermometers. Most of these were placed at 3 ft. above the ground, because experimental readings made in orchards at varying heights above the ground showed that the minimum air temperature at 3 ft. gives the best idea of the average temperature conditions in the usual orchard or plantation. All temperatures mentioned in this article were taken at this height. Screened thermometers were used in preference to bare-bulb thermometers, because experiments show that the one medium of which the temperature can be simply and accurately measured at night is the air, and this is made possible by interposing a screen, made preferably of thin metal, between the bulb of the thermometer and the sky. The thin metal of the screen then radiates its heat to the sky, but experiment shows that it does not cool much below the tem-

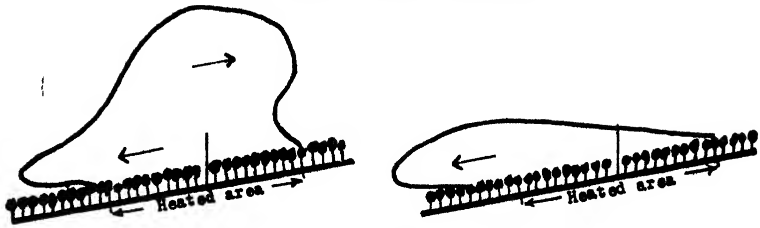

FIG. 3.—Showing the shape of the smoke cloud from orchard heaters at East Malling Research Station. The mast shown in the middle of the heated area is 50 ft. high. The drawing is made to scale, but the slope is exaggerated The shape of the cloud at 5 15 a m. shows a katabatic wind blowing in the first 50 ft. and the hilltop wind at 100 ft. Two minutes later the effect of the hilltop wind had disappeared and all the smoke began to move downhill in a katabatic wind

perature of the air. This is because the metal being thin and a good conductor of heat is able to pick up from the air as much heat as it loses by radiation. Therefore, a thermometer bulb enclosed in a ventilated metal screen is really enclosed in a box having the temperature of the air, and hence gives a reliable reading which may be used for accurate comparisons. A bare-bulb thermometer exposed on a clear, calm night at 3 ft. above the middle of an arable field will record a temperature about 2°F. below that of a screened thermometer placed beside it. If the experiment is tried in an orchard, a similar result will be obtained, but the difference between the two readings depends on the extent to which the bare-bulb thermometer has a view of the sky. The greater the exposure to the sky the more will the two thermometers differ. Hence it is essential for the purpose of this work to fit screens to all thermometers.

Effect of Altitude. Experiments have been made with a line of thermometers placed across a valley in which the fields were either all arable or all grass land. Such experiments have shown that, on most radiation nights, air temperature varies with altitude, the lowest place being coldest.

Temperature differences of the order of 1° or 2°F. per 100 ft. of altitude are commonly caused in this way, as will be seen from some of the readings shown in Table I.

Effect of Vegetation. The effect of altitude on air temperature is well known to fruit-growers, but less well known is the effect of vegetation. Experiments in which thermometers were placed in level fields, some bare and some containing a variety of vegetation, such as grass, raspberries and

TABLE I.—THE EFFECT OF ALTITUDE ON MINIMUM AIR TEMPERATURE

	Hilltop	Valley	Difference Valley minus Hill	Weather at Night
Altitude	353 ft.	50 ft.	303 ft.	
Wateringbury:				
Jan. 16–17, 1937 ..	34·5°	27·5°	− 7·0°	Cloudy, S. wind, rain, frost.
Feb 11–12 ,, ..	30·0°	31·7°	+ 1·7°	Clear, N W. wind, frost
Altitude	250 ft.	60 ft	190 ft.	
Canterbury:				
Dec. 11–12, 1937 ..	32·8°	33·1°	+ 0·3°	Clear, N W wind.
Dec. 16–17 ,, ..	32·0°	33·0°	+ 1·0°	Foggy, N wind.
Feb 14–15, 1938 ..	30·0°	30·3°	+ 0·3°	Snow, N. wind, frost.
Feb. 15–16 ,, ..	30·0°	34·0°	+ 4·0°	Overcast, E. wind, frost.
Mar. 7–8 ,, ..	34·0°	26·2°	− 7·8°	Fog at night, calm, frost
Altitude	325 ft.	100 ft.	225 ft.	
East Malling				
April 16–17, 1938 ..	36·1°	37·3°	+ 1·2°	Clear, E wind, not calm
May 5–6 ,, ..	41·5°	43·0°	+ 1·5°	Very clear, E wind, not calm
May 7–8 ,, ..	30·3°	27·5°	− 2·8°	Cloudy evening, foggy morning, frost

woodland, show that air temperature differences of about 6°F. may be caused on a clear, calm night. As shown in Fig. 4, meadows and a field of clover gave rise to the coldest air, and bare soil and dense wood gave rise to the warmest air.

The accepted explanation for this vegetation effect is as follows:—

The stems of grass are poor conductors of heat, and tend to prevent the heat in the soil from passing up to replace the heat lost by radiation from the blades, so causing the grass blades to be greatly cooled, and they in turn cool the air in contact with them. The heat radiated from bare soil, on the other hand, is quickly replaced by heat from deeper soil layers, so that the air above bare soil is not cooled as much as that above grass. The temperature of the air in a wood varies with the spacing of the trees. In woods with closely planted trees, a complete canopy of branches and leaves, and a dark

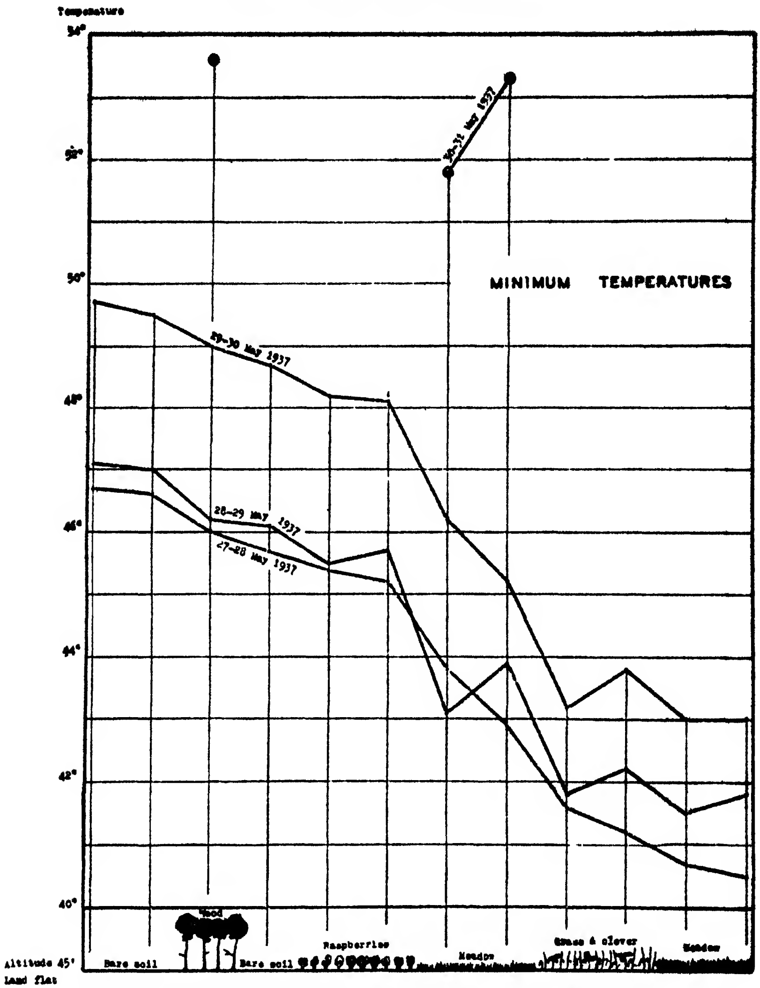

FIG. 4.—Graph of minimum temperatures arranged in descending order, recorded over the crops shown at the bottom on three consecutive radiation nights in May, 1937, at East Peckham. Note that the lowest temperatures occur over grass and the highest over bare soil and in a wood.

interior, the highest leaves exposed to the sky alone radiate heat and produce cold air, which falls into the relatively warm interior of the wood and so is heated up in contact with the branches and ground.

In other fields and orchards the air temperature varies according to the degree in which the crop resembles plain

grass land, bare soil or dense wood. For example, it was found that, in May, 1937, grass growing underneath a canopy of apple leaves and branches in a standard orchard did not have a cooling effect. Air temperature in this orchard was the same as that in a neighbouring field of bare soil, whereas a thermometer that stood over grass exposed to the sky recorded a temperature 2°F. lower. The same experiment was made in other places and gave similar results, indicating that it is only grass exposed directly to the sky that is a source of danger on a frosty night.

An experiment made on the night of June 4-5, 1937, at East Malling Research Station and near it, showed that as great a variation occurred among air temperatures in fruit crops as in other fields. In a cultivated plantation of plum trees the air was as warm as in a dense wood, and in a plantation of widely-spaced bush apples growing over grass the air temperature over grass exposed to the sky was the same as that over a neighbouring meadow. The difference between the temperature of the coldest and warmest air was about 4°F.

An experiment was made to discover to what extent the cold air covering a field of grass could influence the temperature of the air in a neighbouring field of bare soil. Both fields were level and the night was dead calm. A line of five thermometers at intervals of 2 yards was placed at right angles to a fence separating the two fields, the middle thermometer being fixed on the fence. The experiment showed that the warm air warmed the cold air a little, and *vice versa,* but there was still a sharp line separating the cold from the warm air mass. Similar experiments made on sloping land in a katabatic wind moving at 2 or 3 miles per hour gave similar results, and showed that, at least on some nights, the temperature of a katabatic wind depends to a large extent on the crop over which it flows. The truth of this was demonstrated particularly well by an experiment made in a small valley at Leckford, Hampshire, on the night of July 7-8, 1937. By good fortune the higher part of this valley was covered in grass (cold) and the fields in the lower part were arable (warm). The temperature records showed that the lowest temperatures were recorded over the highest part of the valley, the part covered by grass. In the lower part of the valley bottom temperatures were 3.5°F. higher in some places than over the grass in the higher part. This was so in spite of the fact, shown by an anemometer in the valley-bottom, that air

moved down the valley all night, from the colder to the warmer part.

These experiments prove that in gently undulating land, air temperature differences caused by vegetation may be large enough to offset those caused by altitude.

Effect of an Unknown Factor on Air Temperature. Experiments made to determine the effect of altitude on air temperatures have shown as reported above that usually colder air is found over fields in valley bottoms than over similar fields on neighbouring hilltops. The actual difference found varies from night to night; on some nights there is practically no difference, on others the valleys are warmer than the hilltops. Examples of these effects from experiments made near Wateringbury, Canterbury and East Malling are given in Table I. It will be seen, for example, that on the night of February 15-16, 1938, it was 2°F. below freezing point on the hilltop, and 2°F. above freezing point in the valley 190 ft. lower. The factor responsible for this abnormal effect is not known, although suggested explanations have been put forward. The effect is being experimentally investigated.

The Technique of Orchard-Heater Trials. The foregoing observations, and actual experience with orchard heaters, has shown that there are elementary precautions which should be observed when making experiments to determine the effectiveness of orchard heaters. The thermometers inside and outside the heated area must be screened, and placed at the same height above the ground in similar environments, especially with respect to exposed grass. Each thermometer inside the heated area must be centrally placed between four heaters, or at stated distances from them. Thermometers must be read simultaneously and the times of reading stated. It is desirable to read the thermometers at intervals of 20 or 30 minutes. All thermometers should be at the same altitude, except when this means placing thermometers in different environments with respect to vegetation.

It was also found that the cloud of smoky air from the heaters was on most occasions carried right away by either the hilltop or katabatic wind, as shown in Fig. 5. Fig. 6 is a photograph showing similar air movements on a so-called "calm" and clear night.

In view of these observations the following simple experiments are recommended before using orchard heaters.

A SIMPLE METHOD FOR STUDYING KATABATIC WINDS. 1. On

FIG. 5.—Photograph of a river of mist in a valley in a meadow at 7.15 p.m. on September 29, 1937. The mist moves with the katabatic air, thus rendering the motions of the latter visible. The mist river is shown moving downhill to the left and pouring over a stone wall 6 ft. high.

FIG. 6.—Photograph of smoke cloud in the bottom of Leckford Valley on a radiation night showing katabatic wind 15 ft. deep blowing to right and north hill top wind above 15 ft. blowing to left.

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a calm, clear night make a preliminary study of the katabatic winds by using smoke with a view to finding out where the hilltop wind, calm zone, and katabatic winds are.

2. According to the result of the preliminary study, and keeping clear of eddies caused by buildings, set up hanging threads of Angora wool at appropriate places.

3. When conditions are suitable for katabatic winds, place one stationary observer in the hilltop wind and another moving observer to visit the other hanging-thread stations in turn, the two observers making simultaneous observations of wind speed and direction.

4. If air temperature records are to be taken, place screened thermometers at 3 ft. above the soil on stakes.

Practical Conclusions. Up to the present these experiments have shown that:—

(1) Where frost causes damage in orchards on relatively high land, especially on a north-facing slope, it might be reduced by exposing the field in a requisite degree to the hilltop winds.

(2) Topography and vegetation may cause relatively large differences in temperature between one orchard and the next, particularly in low plains and valleys. This fact offers the possibility of raising the temperature of the orchard air by cultural methods designed to store up the sun's heat in the soil.

(3) Temperature variation caused by topography and vegetation, particularly the latter, may account, at least in part, for the unexpected results sometimes obtained with orchard heaters.

(4) It seems wasteful to use orchard heaters in an orchard of widely spaced bush trees where the ground is covered with long rough grass and weeds, because the hot air produced by the heaters may be counterbalanced by the cold air produced by the exposed grass; it might be better to cut the grass and put it round the trunks where it will not be exposed to the sky.

(5) On frosty nights that seem calm there are katabatic winds present on sloping land which are well able to carry hot air out of heated orchards, thereby decreasing the effectiveness of the heaters; so that katabatic and hilltop winds must be given consideration where orchard heating is concerned.

With the above knowledge it should be possible to indicate whether a site is suitable for fruit-growing from the climatological point of view, and, on existing fruit farms to discover by simple experiments on the wind, where orchard heaters are most likely to be successful.

THE MANURING OF GRASS LAND

F. Hanley,
School of Agriculture, Cambridge

Views with regard to the treatment and management of grass land have changed considerably during recent years. It is only within the last half century that the value of wild white clover seed, basic slag and the possibilities of breeding new strains of herbage species have been systematically explored, whilst the use of nitrogenous fertilizers on permanent grass land was, until comparatively recently, regarded as almost bound to lead to trouble. Fuller realization of the respective importance of lime, mineral manures, cultivations, stocking and drainage, together with increasing knowledge of herbage species and the factors controlling the feeding value of grass have brought about a drastic change in the general attitude to grass land management. Investigations now in progress cover a very wide field, but it is often a far cry from the publication of experimental results to their general application in farm practice. A time-lag in this respect may be due to various causes, two of the most common being the cost of materials and the difficulty of cashing any improvement or increase in production. It is often said that it is useless to double the stock-carrying capacity of poor grass land unless the number of stock can be doubled or some alternative outlet can be found for the increase in the amount of herbage. This is not only true from the economic standpoint but also it is wellnigh impossible to *maintain* an improved herbage unless it is adequately stocked or utilized in some way.

This is not the place to go into the question of methods of utilizing herbage, but that is a matter which cannot be divorced entirely from the manurial treatment of grass land. The removal, at the proper time, of the herbage produced is essential to the continued production of high-quality herbage and the maintenance of a good sward just as much as proper manurial treatment may help the production of more or better herbage at times when it is scarce.

During the last eighteen months the management and treatment of grass land has attracted a considerable amount of attention. Financial assistance for the purchase of lime and basic slag, available under the Land Fertility Scheme, thereby

reducing one of the obstacles to the application of the results of many years experimental work on the use of those materials. The importance of other factors in grass land management is also recognized by provision for assistance with drainage and by the publicity given to points such as improvement by ploughing out and re-seeding, and the possibility of some form of alternate husbandry or ley farming in suitable circumstances.

Lime and Phosphate. Though detailed manurial treatment must vary with circumstances, lime and/or phosphate constitute the most common manurial requirements of our grass lands. So much has been written on their use that repetition should be unnecessary. In alternate husbandry, just as much as for permanent grass land, and on pasture and meadow lands alike, adequate supplies of lime and phosphate are essential. The wide general need for one or both of these materials is shown by results at numerous experimental centres. On the heavy gault clay on the Cambridge University Farm there is plenty of lime in the soil, but phosphate has to be applied regularly both on the permanent grass land and on fields cropped on a system of alternate husbandry.

Under the very different conditions prevailing on the Welsh hill grazings, Professor Stapledon has shown that phosphate is again a major manurial requirement.

The response to phosphate on poor grass land on heavy boulder clay soils at Cockle Park in Northumberland and at Saxmundham in Suffolk is also very pronounced, as is the response to lime in such places as the industrial areas of Yorkshire, Lancashire and in parts of Derbyshire. Responses, equally important, but less spectacular, are to be found in many other parts of the country, and, indeed, there is hardly a county where the Agricultural Organizer cannot point to some local experiments or demonstrations showing the importance of lime and/or phosphate in grassland management, and an application of one or other of them is usually an essential step in the early stages of the improvement of poor grass land.

Potash. The need for potash seems to be less universal, but its value is most pronounced on light soils such as sands, gravels and light chalk soils, and on peaty fen soils. Other circumstances in which potash is often desirable are on land that is regularly mown for hay, especially where little or no farmyard manure can be given, and on badly grazed grass where

the lower grade potash fertilizers in particular encourage closer grazing, thereby assisting the development and spread of clovers and bottom grasses. Potash has also a beneficial effect on the establishment of clovers in seeds leys. In general, however, it is well to remember that, though phosphate alone may bring about a marked improvement on some types of grass land, potash alone is rarely a suitable fertilizer treatment and it should usually be accompanied or preceded by an application of phosphate.

Nitrogen. The use of nitrogen in the form of fertilizer requires considerable care. It is even more important with nitrogen than with other fertilizers to keep a strict watch on the management of the grass land. Perhaps the key to the successful use of nitrogen on grass land lies in the appreciation of two factors: first that the most useful grass land is generally that which contains a reasonable combination of both grasses and clovers, and, second, that nitrogen tends to encourage the grasses, usually at the expense of the clovers, but the clovers will not suffer too severely if supplies of lime, phosphate and, if necessary, potash are also maintained, and provided the herbage is removed at the proper time. Among recent papers on this subject those by H. E. Woodman and his colleagues in the *Journal of Agricultural Science* for October, 1938, summarize various aspects of the use of nitrogenous fertilizer on permanent grass land. They show that, under the system of management and manuring adopted in their experiments, including regular dressings of farmyard manure, there was no permanent deterioration either in productivity or quality of herbage (as judged by chemical and botanical composition) over a period of nine years on plots subjected to monthly cuts. Woodman still suggests, however, that in the absence of farmyard manure the only safe course for the production of young grass for conservation is probably to cut and graze alternately in some way. Woodman's results also emphasize the predominant influence of rainfall on yield and on response to fertilizers.

On the subject of the residual effects of sulphate of ammonia, Woodman found that the increase in production of herbage due to the use of periodic dressings of this fertilizer did not account for all the nitrogen supplied in the fertilizer. Nevertheless, when supplies were cut off after five years, the plots that had been receiving sulphate of ammonia gave lower

yields of herbage in the following two years than did plots not previously treated with artificial nitrogen and the herbage itself contained a lower percentage of protein in the first of these two years, probably on account of the reduction in clovers. The clover content of the herbage recovered by the summer of the second year, but it was not until the third year that full recovery in productivity took place, suggesting that artificial stimulation over a period of years by sulphate of ammonia may reduce the inherent vigour of grass land for a time, but that subsequently it may recover its original productivity.

Woodman also showed that the influence of a single, heavy, February dressing of sulphate of ammonia did not extend to the later stages of the season and hence he suggests that, from the standpoint of total production throughout the season, as well as to avoid the risk of excessive " scorching," it is better to give moderate dressings at two or three times during the season to stimulate growth when this is likely to be active, for nitrogen is most effective when grasses are growing most actively.

In general farming practice, nitrogenous fertilizers can be used to advantage on grass to be cut for hay, especially in years when farmyard manure and liquid manure are not available. Provided the supply of other plant foods is adequate, the nitrogen will increase the yield and sometimes the quality of the hay crop without any permanent ill-effects on the herbage. Another direction in which nitrogenous fertilizers are likely to be useful is in forcing growth at times when grass is scarce. Though nitrogen produces its greatest effect at times when growth is naturally active, i.e., at flush periods, it is possible, by an early application to suitable fields, to increase the production of early spring grass where this is needed, e.g., for ewes and lambs. Again, if provision can be made for utilizing flush period growth satisfactorily, nitrogen offers considerable scope for increasing the total yield of herbage for the season.

Farmyard manure is of most value on land that is to be mown for hay, but even where considerable quantities are available it is best not to use it more often than once in two years, and a dressing every third year is adequate in most circumstances. Annual dressings are apt to lead to coarse, weedy herbage and even less frequent applications must be balanced by regular applications of phosphate and lime where

necessary. Farmyard manure has also a special value sometimes in helping a poor thin sward to "get together" and in fostering the establishment and growth of a young seeds layer, especially on land in a low state of fertility.

Manuring and Quality of Herbage. It is convenient to judge this effect in two ways, firstly, the effect of manuring on the different species of herbage plants, and, secondly, the effect of manuring on the chemical composition of the herbage. It is not possible in this article to do more than briefly indicate some of the more important effects. The possible influence of manuring on herbage species is seen in marked degree on the Park Grass plots at Rothamsted. The unmanured plots carry many species, though the yield of hay is low. Mineral manures, whilst not markedly reducing the number of species, encourage a larger proportion of leguminous plants. Nitrogen, on the other hand, is associated with a big reduction in the number of species, sulphate of ammonia being more potent in this respect than nitrate of soda. These effects are the result of long continued treatment but they serve to indicate what may occur when no steps are taken to balance up the manuring of grass land. Unbalanced manuring, by unduly favouring one species at the expense of others, may actually reduce productivity.

As regards chemical composition, manuring may affect both the protein and the mineral content of herbage, either directly or by influencing the proportion of clovers.

Data published in the Cockle Park Report for 1937 give some idea of the possible magnitude of these effects.

ANALYSES OF HERBAGE FROM COCKLE PARK PLOTS—SEASONS 1930 AND 1934

(Samples obtained by cutting at fortnightly intervals throughout the season)

Manuring	Yields in lb. per Acre							
	Dry Matter		Crude Protein		Phosphoric Acid (P_2O_5)		Lime (CaO)	
	1930	1934	1930	1934	1930	1934	1930	1934
Control	*3,963*	*3,963*	*322*	*349*	*16·3*	*13·3*	*26·9*	*22·0*
* Basic Slag ..	3,747	3,510	503	529	38·9	27·2	31·3	36·1
† Slag + Lime	4,307	3,094	520	470	49·2	24·5	59·2	45·2

* 5 cwt. per acre every 3 years.

† Slag as * plus lime at 1 ton per acre every three years.

It will be seen from the preceding figures that not only the lime and phosphoric acid, but also crude protein shows a substantial increase on plots receiving lime and basic slag even when the total production of herbage dry matter was not increased. The place of minerals in the nutrition and disease of live stock, and the relative merits of different sources of minerals, are still subjects of much research work, but their importance cannot be denied, especially as regards dairy cattle and other breeding stock. It is an elementary precaution, therefore, to keep up the supplies in the grazing as far as possible.

The effect of nitrogenous fertilizer on the chemical composition of the herbage may be very striking. Grasses seem to be able to utilize ammonia directly, and hence, though heavy doses of sulphate of ammonia may reduce the proportion of clovers in the herbage, they may actually increase the content of crude protein. That a considerable increase in crude protein can be obtained in some circumstances, is shown by Woodman's experiments with light and heavy February dressings of sulphate of ammonia which gave the following results:—

Sulphate of Ammonia per acre in February ..		⅝ cwt.	3⅛ cwt.
Percentage of Crude Protein in Dry Matter of Herbage in late March	1932	22·8	30·6
	1933	19·7	25·0

Thomas and Moon, analysing herbage from plots at Cockle Park, have recently shown a further interesting effect of manuring on quality of herbage. Using monthly applications of sulphate of ammonia (1 cwt. per acre), and cutting at monthly intervals from June 10 to September 30, they found an average carotene content of 58.0 mgm. per cent. of dry matter in the produce from the sulphate of ammonia plots as against 43.4 mgm. per cent. in the produce from untreated plots. The herbage from the untreated plots had a lower carotene content at every cutting.

Some of the above results, e.g., the effect on carotene content, may seem to be of more immediate interest to the producer of dried grass than to the ordinary farmer, but the value of grass land must be judged not merely by its yield of herbage, but also by the quality of that herbage and its ability to support healthy stock, whether used as pasturage or conserved for winter feeding.

A TREATMENT FOR SLIPPERY COWSHED FLOORS

W. A. SCRIVEN,
County Agricultural Instructor, Shropshire,
AND
R. KENNEY,
County Lecturer in Dairying, Staffordshire Farm Institute

Agriculturists have long realized the danger, inconvenience and financial loss caused by slippery cowshed floors, usually due to such reasons as:—

(1) Faults in the mixing and finishing of the concrete.
(2) Insufficient washing of the floors with water.
(3) Too steep a fall in the floors.

It is no uncommon sight to see cows with injured backs and hindquarters, big hocks, and damaged udders. The majority of these blemishes are caused by animals falling when being brought in or turned out of the cowshed, because the floor has become smooth or slippery. On such floors, animals are naturally nervous, and this condition will undoubtedly affect milk yield, especially when an animal slips or falls on the floor prior to milking. Besides the risk to animals, workmen have to move about the shed cautiously, and even so, accidents sometimes happen.

Various methods of roughening smooth floors have been tried. An old and still common practice is to chip the concrete with hammer and chisel. This is a long and tedious operation and not very satisfactory. Another is to roughen the surface by using an electric or pneumatic drill, but, although this is quicker than the chisel method, it is still tedious, and the floor left pitted and difficult to clean. The spreading of carborundum powder or sand on the surface has been frequently recommended. Although this prevents slipping for the time being, it cannot be claimed to be effective for any length of time.

Hitherto, slippery floors have received only mechanical treatment and even then with comparatively little success. It was felt that there was an urgent need for some efficient, economic and simple method of remedying this trouble.

Observations in the past led us to consider the possible use of chemicals. Cheese makers know from experience that tiles

FIG 1 Treatment of floor with acid

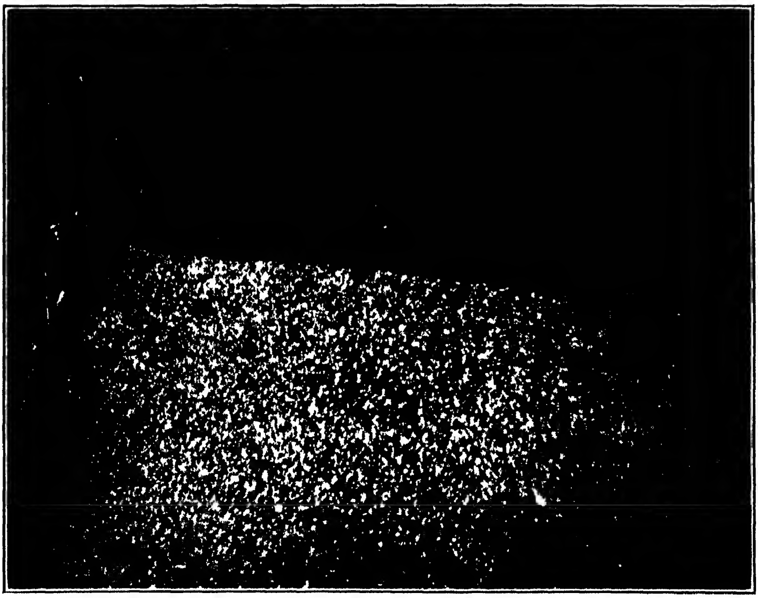

FIG 2 —Floor partially treated. Dark area showing smoothness before treatment, light area showing roughness after acid application

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or blue bricks make a better dairy floor than concrete, which slowly disintegrates under the action of whey, which contains 3 per cent. lactic acid. It appeared that a mineral acid might be used for treating smooth concrete floors, and it was decided with the co-operation of Mr. W. Morley Davies, Advisory Chemist, Harper Adams Agricultural College, to conduct experiments.

At first, smooth slabs of concrete specially cast for the purpose were treated in the laboratory with acids of varying strengths. Hydrochloric acid readily attacked the carbonates in the cement, leaving the sand and granite as a rough surface. The time taken to roughen the surface to the desired degree depended on the strength of the acid, even dilute solutions being effective, though the weaker the acid the slower the process. The rate of roughening was dependent on the degree of hardness of the concrete.

When concrete is treated with hydrochloric acid the chemical action causes considerable effervescence and acid fumes are also given off. After a time, chemical action ceases, though this action may be stopped at an earlier stage by applying soda solution, an alkali which neutralizes the acid.

The preliminary laboratory tests having proved satisfactory, treatment on a large scale was planned.

Two centres were selected: the Staffordshire Farm Institute, Penkridge, Stafford, and Mr. Stephen Ward's Farm, Kinnersley, Salop. The actual treatment adopted, with the results of the operations at each of these centres, is outlined below.

STAFFORDSHIRE FARM INSTITUTE. Trials were first carried out to ascertain (*a*) the strength of acid which would be most suitable, and (*b*) the length of time the acid should be left on the floor.

The conclusions reached were that 25 per cent. commercial hydrochloric acid left on the floor for 20 minutes proved the most satisfactory for this particular floor.

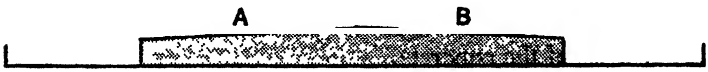
The shed was of the double row type, accommodating sixty animals, with a centre gangway 112 ft. long and 6 ft. wide. Two men carried out the whole of the treatment, the gangway and later the beds being treated as follows.

Clay was first built up along the edge of the gangway for 6 yards on either side and at the drain outlets. The diluted acid was then poured from an enamelled bucket along the middle of the passage and gradually allowed to run to the outside edges.

Further acid was applied as required, and after 20 minutes the floor was washed with water.

This seemed to be rather a wasteful method and on the next 6-yards section one man applied the acid, while the other used a stiff brush to prevent it running to the outside so quickly. This reduced the quantity of acid required. On washing the floor, it was also found that a much better roughening had been obtained than with the first method.

On the next section, the clay was dispensed with except for blocking up the outlets to the drains, the gangway being treated in two sections, A and B, as shown in the sketch. The acid which overflowed into the channels was used for roughening their surfaces.



Before releasing any liquid down the drains, the gangway and channels were washed with soda solution to neutralize any unexhausted acid. The rear portion of each standing was then treated in a similar manner to a depth of 2 ft. 6 in. The complete operation took five hours in all.

After six months, the floor surface has fully maintained its roughened character, and it appears it will do so for a considerable length of time.

Since the treatment, the animals have not been observed to slip and neither have they shown any signs of nervousness when being brought in or turned out, and no bad hocks have occurred since treatment.

MR. STEPHEN WARD'S FARM. After a preliminary trial on a double standing, to ascertain which strength of acid would be most effective, it was decided to use full strength commercial hydrochloric acid.

The surface of the floor was thoroughly washed and scrubbed to remove all trace of dirt before the acid was applied. A small ridge of clay was placed with a trowel along the back edge of the standing, as shown in Fig. 1. This was done to keep the acid on the sloping bed and to prevent the acid from attacking the back edge of the bed, where wear is usually most severe.

This treatment having proved satisfactory, it was decided to treat the whole of the shed. A ridge of clay was placed along the back edge of about six double standings. This procedure

saved time and made it possible to treat more than one pair of standings at a time, and economized in the use of acid since the residue from one standing could be brushed on to the next.

Two men, one on either side of the carboy, carefully poured the acid into an enamelled jug. *On no account should this job be treated lightly, as any spilling of acid may have dangerous consequences.* The acid was then poured as evenly as possible over the floor of several double standings at a time. A man with a well-worn broom then brushed the acid over the surface to prevent too strong a concentration in any one place. The acid was left to attack the floor for approximately fifteen minutes. When chemical action subsided, a squeegee was used to transfer the acid to the next untreated standing, where it still had some action on the concrete.

This procedure was followed throughout the cowshed, further application being made when necessary.

When the top end was reached, the waste acid was brushed into and along the channel to start roughening the surface. The backwalks were roughened in the same manner. On completion the ridge of clay was removed and the floors flushed with water, followed by a thorough washing with soda solution to neutralize any remaining traces of acid.

After the cowshed floors had been roughened, it was observed that the cows coming in or going out of the sheds walked confidently and safely, without the signs of fear and nervousness which were so apparent when the surface was smooth and slippery.

Materials Required. One or more carboys of commercial hydrochloric acid, depending on the area to be treated and the hardness of the concrete. Approximately one carboy (10 gal. of undiluted acid) is sufficient for 58 sq. yds. of floor.

An old enamelled jug or bucket for pouring on the acid.

A trowel and a bucket of well-puddled clay.

A worn, stiff broom and a squeegee.

It is advisable that workers should wear old mackintoshes, rubber boots and rubber gloves.

A good supply of water is essential for washing down the floors after treatment.

Care to be Taken in Treatment. Some responsible person who fully appreciates the need for care in handling acid should supervize the operations.

All windows and doors should be kept open, as the fumes which are given off when the acid is applied to the floor may cause slight headaches, and on no account should animals be in the shed during the treatment.

Care should be taken that no acid leaks into the drains as it eats away the cement joints. Drain entrances should be stopped up with clay before treatment begins, and effluents allowed to run away only after the work has been washed down with water and soda.

The cost of the treatment does not exceed 10*d*. per cow even with extremely hard floors.

As this work may be carried out at slack periods, labour charges may be omitted from the calculations. The amount of acid stated includes that used to carry out the preliminary trials.

Costs.

STAFFORDSHIRE FARM INSTITUTE.

	£	s.	d
Two 10-gal. carboys of commercial hydrochloric acid ..	1	0	0.
14 lb. washing soda	0	1	0
Labour—Two men for 5 hours at 10*d*. per hour .. .	0	8	4
Total cost for treating a cowshed for 60 cows	1	9	4

Cost per cow = 6*d*. (approx.).

MR. STEPHEN WARD'S FARM :

Three single tie cowsheds, including standings, channels and back-walks for 32 cows were treated.

	£	s.	d.
Two 10-gal. carboys of commercial hydrochloric acid ..	1	0	0
14 lb. washing soda	0	1	0
Labour—Three men for 3 hours at 10*d*. per hour ..	0	7	6
Total cost	£1	8	6

32 cows at £1 8*s*. 6*d*. gives an approximate cost of 10½*d*. per cow.

MECHANICAL ROW-CROP CULTIVATION

S. J. Wright,

Director, Institute for Research in Agricultural Engineering, Oxford

During the last few years the adaptation of tractors to row-crop cultivation has become a matter of great importance to both farmers and engineers. Interest in this particular problem is widespread because, unlike most of those associated with mechanization, it is almost as important to the small farm as to the large. It is true that the use of tractors for row work is only *essential* on the fully mechanized farms where sugar-beet and similar crops are now being introduced both to give a better balance to mainly-cereal rotations and to give a more even distribution of labour requirements over the year. On such farms it is a necessary condition when any row-crop is introduced that, apart from singling, lifting and other operations involving direct hand work, it shall be capable of being cultivated with the normal tractor equipment and with the very small labour force ordinarily available. But, almost at the other end of the farming scale, tractors are coming into use in very large numbers on quite small mixed holdings, and here, too, there is a growing desire to use them for inter-row cultivations. Here the reason is not that horses are not available but that very often the farmer considers that the purchase of a tractor can only be justified if it is going to be used on every possible occasion. Yet another reason for interest in mechanical row-crop equipment is to be found in the fact that on nearly all arable farms to-day there is a tendency to supplement, or partly to replace, the normal root shift with vegetables or some other cash crop. And with these potentially more valuable crops the tractor's greater speed of working counts for a great deal when due regard is paid to the advantages of getting cultivations done at the best time.

Two other points which should give the problem of providing tractor row-crop equipment a special interest for British implement makers may be mentioned. The first is that this is essentially a small tractor problem, so that, whatever the size of the holding, the equipment required is very much the same. On the one-tractor farm the tractor will almost certainly be a low-powered one; on the large farm most

of the row-crop work will be added to the duties of the low-powered, odd-job machine which is generally available. The other point is that, particularly when it comes down to the details of hoes and so forth, the row-crop problem is closely dependent on local conditions and circumstances. It cannot easily be solved by importing ready-made appliances from abroad; and, simply through being on the spot, our manfacturers should have a useful advantage over their overseas competitors.

With all these considerations in mind, it is clearly of interest to enquire what progress has been made and to ascertain how far row-crop equipment suitable for general use up and down the country is available. In an attempt to assess the present position, the Institute for Research in Agricultural Engineering has carried out, during the last few months, an enquiry, covering about 50 farms carefully chosen, on the information available, as being typical of the various classes of holdings on which serious efforts are being made to use tractors for row-crop work. The detailed results of this enquiry will shortly be published by the Institute as a Bulletin; in the meantime, some considerations arising from it may be mentioned.

Perhaps the most interesting general point is that, almost without exception, every row-crop operation ordinarily performed with the aid of horses is being carried out somewhere in the country with tractors alone. From this one might conclude that completely mechanical row-crop cultivation is a practical possibility on any farm; and yet, to judge from the farms concerned in the enquiry, it is only in very rare instances that horses have been completely eliminated even from the cultivations of one particular crop. Very often, of course, horses are used for row work which tractors would otherwise undertake, simply because they are required—or are thought to be required—for other jobs on the farm. Quite apart from this, however, it seems clear that one reason why tractors are used less often than they might be is that there are still serious gaps in the range of available tractor equipment. Evidence in support of this conclusion is to be found in the fact that whenever one visits a farm on which row-crop cultivation has been completely mechanized, it is at once obvious that the equipment used owes a great deal to the personal ingenuity of the particular farmer concerned. Standard equipment to cover perhaps two-thirds of the row-crop requirements of the average

farm can be bought, as it were, over the counter; the rest of the work still requires some special set-up of the farmer's own contriving. A particular example is to be found in connexion with potato growing and the much-vexed question as to whether tractors can or cannot be used successfully to run along the ridges for covering-in. A few farmers use planting machines—some of them home-made—which cover as they go so that the ordinary difficulty does not arise. At least one man uses a tracklaying tractor specially adapted for the purpose at considerable expense. And many others dodge the difficulty by doing their covering indirectly—generally with some small loss of time and money. Actually, however, there would appear to be no great difficulty from an engineering point of view in providing equipment which would enable covering-in to be done with tractors without difficulty and as a matter of ordinary routine.

One factor which affects the use of tractors with nearly all root crops is transport from the field at lifting time. Some farmers hold that horses must be retained for carrying just because under their particular conditions tractors could not get along except when the land is dry. In a few districts, such as in some parts of the Fen country, this may be true, although even here it may be asked in the future whether it is really the tractor or the farm road that is at fault. On the other hand, root crops and potatoes are being hauled off successfully with pneumatic-tyred tractors—and sometimes from quite heavy land—in districts as far apart as Worcestershire and Aberdeen; and the farmers concerned use tractors simply because they are sure they save money by doing so. Nevertheless, it is quite clear that on the small farms—on which in the aggregate the greater part of our potatoes and roots are grown—it would be out of the question to mechanize lifting and hauling-off at all completely simply because the one tractor to which the farm is generally limited just cannot be split into the three or more units that would be essential to economical working. Even the most highly-developed power unit cannot haul, say, a potato-spinner and two carts in three different places at the same time. And if horses have to be available in any event there are many row-crop operations in which, having regard to the equipment ordinarily available, it is not easy to make out an economic case for using tractors. Let us consider ordinary inter-row hoeing for example. In this country, one rarely sees a tractor hoeing more

than four rows of sugar-beet at once. This would generally be within the capacity of a single horse—in fact, on the Continent one will frequently see a pair of horses or oxen hoeing up to 10 rows—and in the ordinary way a pair of horses are considerably cheaper than a tractor to maintain. Making every allowance for the tractor's greater speed, and its ability to work long hours without fatigue, one is bound to conclude that due to lack of proper equipment and the consequent lack of experience in using wider toolbars, most of the tractors used for hoeing and similar work at present are being worked uneconomically.

This is yet another question in regard to which success at the moment depends too much on personal ingenuity—and about which direct evidence was to be found on the farms visited by the Institute. On one farm, a 9 h.p. tractor was operating, as a matter of ordinary routine on 18-in. rows of sugar-beet, an 8-row hoe outfit of the farmer's own design; and in the course of trials of experimental equipment had shown that it had ample power for 12 rows. On a very similar crop only a few miles away, two 4-row hoeing outfits were operating side by side: one of them was operated by an 18 h.p. track-layer and the other by a market-garden cultivator of possibly 6 h.p. What all this amounts to is that somewhere around one horse-power per row should be quite adequate for at least three-quarters of our root area, and yet nearly every tractor-worked farm uses about three times this power. The main reason is the lack of suitable equipment, which in turn is partly due to lack of co-ordination between implement makers. It is useless to possess an 8-row hoe outfit unless there is a drill of similar size to match it; and while we have perhaps twenty root-drill manufacturers and a similar number of firms making hoe equipment, only an odd firm here and there—generally with only a localized connexion—makes both hoes and drills. This, of course, is not the whole answer to the question, for the majority of our farmers would probably maintain that even if they had appropriate 8-row equipment they would be unable to operate it; their seedbeds would not be level enough, their headlands would be too wide, and so on. Yet one must repeat that equally wide outfits are actually used, with horses or oxen all over the Continent, and with tractors by a few farmers in this country. Naturally enough, special attention to seedbed preparations is essential and the work must be planned to offset the headland difficulty—in fact,

as one well-known sugar-beet grower has pointed out on more than one occasion, the whole sequence of cultivation operations must be planned as part of one scheme—each being carried out with the special requirements of subsequent operations in mind.

It is not to be assumed, of course, that tractors can be provided with implements adequate for their power and working cost by merely doubling the width of existing types of equipment. In fact, if one might be permitted, quite independently of the farm enquiry referred to earlier, to hazard a guess about the equipment of the future, one would feel inclined to suggest that it will be quite unlike the tractor outfits of to-day and much nearer to the horse-drawn outfits of the last generation. For the directly-attached hoe frame controlled solely by the tractor driver is likely to be but a poor substitute as regards accuracy and efficiency of working for the old-fashioned steerage hoe. And once an independent steerage is provided there is no longer any point in attaching the implement directly to the tractor. On the contrary there are definite disadvantages in direct attachment—for example, the time lost in coupling and uncoupling, and the fact that very often the tractor driver and the rear steersman must work in opposition to one another. From all points of view the logical course would seem to be to use the tractor simply as a fore-carriage and to make the rear portion differ from an extra-wide steerage horse hoe only in having some form of depth compensation and a seat for the steersman.

This, however, is a digression, for this article set out, not to predict the future, but to describe the present. And this, for the present purpose, may perhaps be summed up by saying that, although complete root-crop mechanization for everyone is—perhaps fortunately—not yet a practical possibility, yet an enormous amount of useful information—relating to a much wider range of crops than has been touched on here—is to be found in the methods and implements worked out by individual farmers here and there all over the country. In fact, the writer's personal reaction on reading the draft report on the 50 farms mentioned was to wish that the enquiry could have been extended to cover 500 others like them.

THE STRAWBERRY PROBLEM

R. Wellington,
Worth, Devon

At long last it seems as though the clouds which have overshadowed commercial strawberry growing these many years are lifting. The industry is still far from being in a healthy state, however, and very drastic reorganization will be required if the benefits of recent research are to be utilized.

This is therefore an opportune time to take stock of the present position; to look back on our failures, and see if with our greater scientific knowledge we cannot overcome the difficulties of the past.

If anyone doubts that strawberry growing has been under a cloud, let him ask any grower who has cultivated the crop for 20 years or more what his experiences have been. Hardly without exception the answer will be—a continuous series of poor crops, with plants which remain unhealthy and weak notwithstanding the use of every known cultural means to improve them, but interspersed nevertheless, for some unaccountable reason, with an occasional normal or heavy crop.

Throughout this time most growers have realized that though their cultural methods were frequently not all they should be, yet the main cause of the trouble was some disease or unhealthiness factor in the plants themselves. They found also that, by careful rogueing and selection of the runners, improved results were frequently obtained, and further, that certain strains and certain varieties had either greater resistance, or less of the disease, and hence yielded heavier crops.

As a result of research work carried out mainly at the East Malling Research Station in Kent, by Mr. R. V. Harris, Dr. Massee and Mr. W. S. Rogers during the last ten years, we now know that various virus diseases are the general cause of loss of vigour, and low prolificacy in strawberry plants. It has been demonstrated that, provided virus infection can be kept at a low level in the fruiting plantations, very heavy crops of fruit may be picked.

There are three distinct strawberry viruses—Yellow Edge and Severe Crinkle, each of which causes, ultimately, complete destruction of the plants; and Mild Crinkle, which seems of little economic importance.

The cropping comparison is somewhat as follows:—2 tons

per acre is the yield the textbooks say should be obtained; 15-25 cwt. per acre the general yield from virus-infected commercial plantations; and 3-4 tons per acre not unusual yields for virus-free plantations.

A careful study of how our present-day varieties have been obtained, of the history of commercial strawberry growing, as well as of the various diseases, is necessary if we are to replan our methods and obtain these heavier yields regularly.

Large-fruited strawberries originated in Europe from crossing the indigenous American species *Fragaria virginiana* and *Fragaria chiloensis* with another species of uncertain origin, *Fragaria grandiflora* or *ananas*—the Pine Strawberry.

Fragaria virginiana, generally known as the Scarlet Strawberry, was introduced into France from the Atlantic Coast of North America prior to 1624. It was described as being grown in this country in 1629. For many years and until about 1820, the Scarlets were the chief varieties in general cultivation in the British Isles.

Fragaria chiloensis, the Chili Strawberry, is indigenous to the Pacific coasts of North and South America. It was introduced to France about 1716 and was brought to this country by Philip Miller in 1727. Owing to the lateness of its flowering and to the plant's habit of producing only pistillate (female) flowers, the original plants remained sterile for some years. It was not until they were planted close to some late-flowering plants of the other species that ripe fruit was obtained. This dioecious habit remains in many of our Chiloensis-type varieties, particularly Tardive de Leopold, and to less extent, Oberschlesien. *Fragaria chiloensis* was little cultivated in this country in those early days of strawberry growing, and in 1824 only three varieties were known. On the Continent, *Fragaria chiloensis* has been largely used for hybridizing, and consequently the main European varieties, as distinct from the British, are of this type.

In this country Knight and Keen were the first to hybridize these original species. Knight apparently mainly used the cross *Fragaria virginiana* with *grandiflora,* whereas Keen used *Fragaria chiloensis* with *grandiflora.* In 1818, Knight raised over 400 seedlings; and of these, Elton Pine and Downton had larger fruits than any in previous cultivation and became widely grown. Keen, on the other hand, from a Chili cross in 1808 produced Keen's Imperial, and using this as a parent, in 1821 he produced Keen's Seedling. This variety had very

large fruits, and when exhibited at the Horticultural Society's Show in London created quite a sensation. Keen's Seedling was really the first large-fruited strawberry and held its own as a market variety until 1870. It seems to have been the ancestor of most, if not all, of the British varieties cultivated before the War. Except for the production of Keen's Imperial, *Fragaria chiloensis* varieties seem to have been used less and less in producing the original British large-fruited varieties. Instead, *Fragaria virginiana* (The Scarlet) and *Fragaria grandiflora* (The Pine) have been used almost exclusively and our older varieties may now be said to belong to a Virginiana group.

There is a distinct difference between the Virginiana and Chiloensis groups. In the former the leaves are generally lightish green, brittle; the fruit rather pointed, of brilliant red colour and excellent flavour. Royal Sovereign, The Duke, Laxton and Stirling Castle are typical varieties. In contrast, the latter group has dark, rather roundish leaves of tough and leathery texture. The fruit is generally large, rounded, often hollow, purplish red in colour and poor flavour. This group is represented by Madame Lefebvre, Madame Kooi, Oberschlesien, Tardive de Leopold, Brenda Gautrey, Western Queen, etc.

As far as this country is concerned, few Continental varieties of Chiloensis type were imported until after the War. Since then, however, many have been brought in, and in addition, the new varieties raised in this country during the same period have nearly all been of this type.

As will be seen later, these Chiloensis type varieties have an important bearing on our plan to improve production by maintaining virus-free stocks. They constitute a grave danger to our commercial strawberry industry, and so long as they are in general cultivation, a slow, though sure, disease deterioration in all our stocks must take place.

Commercial strawberry growing, until quite recently, has been a centralized industry, concentrated in special areas. In the main, these areas were grouped in close proximity to large towns; hence we find the Middlesex, Kent and Essex areas supplying London; Evesham supplying Birmingham; Cheddar, Bristol; Holt and Wrexham, Liverpool and Manchester; the Valley of the Clyde, Glasgow. But certain other areas have developed because of special soil or climatic conditions. Near Southampton in Hampshire, the Tamar

Valley, in Devon and Cornwall, and near Brest in Brittany, on account of earliness; and around Wisbech in Norfolk and Cambridgeshire and near Breda and Goes in Holland because of heavier crops.

One can learn much from tracing the history of these areas. All once very flourishing, they have now long passed their zenith and are at present in various stages of disintegration. Let us consider in detail, first the areas in Middlesex, Kent and Essex supplying London, and then that around Southampton in Hampshire.

The original strawberry area supplying London was in Middlesex, in Chelsea and Chiswick. Later, either because the land was required for building, or because the beds became unprofitable, this area disappeared, and was succeeded, in the middle of the last century, by another around Isleworth and Hounslow. This area lasted from 30 to 40 years, but had disappeared long before the land was required for building, to be replaced by the North Kent area around Bexley and Swanley. Thirty or forty years later the beds in this area were in a state of decay, to be replaced by more scattered areas in the Maidstone and Sittingbourne districts, in Kent, and other similar areas in Essex. Strawberries are still grown fairly extensively in these areas, but the yields generally are poor, and it rather looks, if things remain as they are, as if the acreage will gradually shrink to a negligible quantity. Meanwhile, new plantations in new and still more scattered areas are replacing them.

In the areas around London, which have been devoted to concentrated strawberry growing, much of the land previously occupied by strawberries has now been utilized for building, or else, on account of its situation and character, for other crops. One does not therefore see the effect which continuous strawberry growing over a long series of years produces on the land. This is not so in the Southampton area of Hampshire. Originally centred closely around the villages of Swanwick and Botley, 30 to 40 years continuous strawberry cropping has left much of the land—a light, sandy soil—completely derelict, growing little but masses of sorrel to advertise its acidity and destitution. The growers, in their struggle to exist, have taken more and more fresh land on the periphery of the area, until now most of it has been utilized at some time or another, and the exodus has proceeded even as far afield as the New Forest, 20-25 miles away.

Each of these other concentrated strawberry areas, whether here in Great Britain, or on the Continent, has passed, or is passing, through similar experiences.

It is obvious, therefore, that this problem of producing satisfactory commercial crops of strawberries has existed for a very long time. In the past, as a result of poor communications and other factors, strawberry growing has remained localized, but even so, the problem has caused first one area and then another to disappear. And now, with the annihilation of distance and the destruction of individual isolation, the problem of the concentrated area has become the problem of the small area, and even of the individual grower.

What is the root cause of this gradual but continuous disruption of the strawberry-growing areas? In the main it is the result of a departure from that sheet anchor of all successful agriculture—rotational cropping. To succeed in maintaining heavy yields over a long series of years with any crop, whether it be wheat, the other corn crops, potatoes, market-garden crops or strawberries, some system of rotational cropping has to be adopted. If this is neglected, the land becomes so impoverished chemically or in its organic content and bacterial flora, that the particular crop which has been grown continuously ceases to flourish and becomes an easy prey to disease. Equally serious, infections of these diseases become so piled up, as a result of excessive and abnormal concentrations of the crop in a very circumscribed area, that mass infections result, and the plants and their crops are destroyed.

One can say, therefore, that provided we commence strawberry growing in isolation, with suitable soil and climatic conditions, and follow a system of rotational cropping, then heavy crops should result, provided our culture is correct.

In part this is so, but there is this further proviso. We know from recent research work that the chief disease factors which cause loss of vigour in strawberry plants, and consequent loss of crop, are the various virus diseases. The elimination of these is equally as important as rotational cropping. In fact, the one is complementary to the other.

Virus diseases exist in the plant tissues only, and their transference from plant to plant requires some external agency (a vector), usually a sucking insect. The only known vector of the various strawberry viruses is the Strawberry Aphis (*Capitophdrus fragariae*). It follows, therefore that even in

isolation, and by following rotational cropping, we cannot maintain our plants healthy year in and year out unless we commence with healthy plants. And having done this, we must maintain our beds, not only substantially free of virus-infected plants, but also substantially free of the insect vectors of these viruses.

It will readily be seen that a few virus-infected plants in a bed cannot in themselves cause any spread of the disease unless the insect vectors are present, and conversely, the insect vectors cannot spread the virus unless they are themselves infected by feeding on virus-infected plants.

A further complication and danger arises from the fact that *Capitophorus fragariae*, in common with most other aphides, produces a winged form at certain periods of the year, which migrates. It is in consequence of such migration that isolation is so important, for if healthy beds are close to unhealthy ones, there may easily be an interchange of the returning migrant aphides from the unhealthy beds to the healthy beds, and *vice versa*. In the former instance, virus outbreaks will occur, to extend, if no steps are taken, until general infection of the beds results, and they commence to deteriorate rapidly.

The production of completely or substantially virus-free strawberry runners in quantity is a necessity if new, isolated plantations are to be healthy from the start. To achieve this, new methods of runner production are required. More will be said of this later.

The question of variety in connexion with the production of virus-free strawberry runners is also all-important. On pages 1009 and 1010 the manner in which our present large-fruited strawberries have been bred was described. The various varieties at present in cultivation are shown to fall into two groups. The Virginiana or British Group, including Royal Sovereign, The Duke, Laxton, Sir Joseph Paxton and Stirling Castle. The Chiloensis or Continental type, including Madame Lefebvre, Madame Kooi, Oberschlesien, Tardive de Leopold, Brenda Gautrey, Western Queen, etc.

Of these two groups, the Virginiana or British Group varieties have generally lightish green, brittle leaves, and are more delicate, and less robust in growth, than the varieties of the Chiloensis or Continental group, which in contrast, have dark green, tough, coarse leaves, and are more vigorous.

The strawberry virus diseases which have already been

mentioned affect varieties of both groups, but the Virginiana varieties have much less resistance to virus infection than the varieties of the Chiloensis group, and consequently are destroyed much more quickly. Most important of all is the fact that, whereas varieties of the Virginiana group show virus disease symptoms soon after infection, these same symptoms in varieties of the Chiloensis group are masked, and seldom, if ever, appear, even when the plants are heavily infected. All that is noticed in infected plants of the Chiloensis group varieties is a gradual deterioration in vigour and loss of crop, until the plants actually die or become very small and quite unprolific.

It is obvious, therefore, that the successful elimination of virus diseases from our strawberry plantations, and the maintenance of healthy beds, depends on discarding all these symptomless, carrier varieties of the Chiloensis or Continental group, and on replacing them with varieties of the Virginiana or British group, in which early virus infection can easily be recognized and consequently eliminated.

Completely virus-free plants are only known in the variety Royal Sovereign, though what would appear to be clean plants of Sir Joseph Paxton are now under final test. It may well be that clean plants of other old Virginiana group varieties, such as The Duke, Stirling Castle, Laxton, etc., may yet be found.

In contrast, no known clean or virus-free stock of any of the Chiloensis group varieties exists.

The strawberry grower who wishes to keep his plantations healthy and to obtain heavy crops must at present, therefore, restrict himself to the variety Royal Sovereign.

It would appear essential that our plant hybridists should concentrate on raising new virus-free varieties of the Virginiana group, and discontinue raising new Chiloensis group varieties, which are such a danger to all strawberry growers.

With this knowledge, it should now be possible to plan a method, first, for producing healthy runners and then healthy fruiting plantations. The first essential in runner production is to dissociate the runner beds from the fruiting plantations. The old method of taking runners from maiden (one-year-old) fruiting plantations must be discontinued, for the runners in such plantations become so inextricably mixed that it is not possible to rogue them effectively. Nor is it possible to give

the plants the attention they require in spraying for Aphis control.

A special bed for runner production should be planted and managed in the manner described by Rogers.[18] If this bed is to be a success, plants of a known virus-free stock must be planted, and the bed itself must be as isolated as possible (½ mile is the very minimum) from all other known strawberries. With many growers such isolation will be impossible to obtain, particularly in the large areas, and growers in these should give up the idea of raising their own runners, and instead purchase their supplies from specialist raisers of virus-free plants.

The expense of raising runners of this calibre by this method is considerable, and they cannot be sold for less than 40*s*. or 50*s*. per 1,000. Such first cost may seem excessive, but seeing that an increased return of as much as £80 to £150 per acre annually for two or three years may result, the money is well spent.

Isolation is important in the fruiting beds also. New fruiting plantations should be as isolated as possible from older beds, and from the beds of other growers. It is here that growers with sufficient land to allow the strawberry crop to be included in a general farming rotation reap the benefit. It is futile to plant clean stock in close proximity to, or immediately following, old infected stock, and to expect the beds to remain healthy and the resulting yields to be satisfactory. Preferably, before making such new, clean plantations, all heavily-infected older fruiting beds should be ploughed up.

The productive life of these new plantations of virus-free stocks will depend on the extent to which the various virus diseases creep in and extend annually. In the concentrated strawberry areas two, and at most three, productive years is the most that can be expected. With isolation, the life may be anything up to seven years—though for the benefit of the new plantations which will be made, it is probably good policy to plough up all fruiting beds after three crops, for by this time they are certain to be extensively virus infected.

Inasmuch as virus-free plants grow so vigorously, the distance at which they are planted between the rows and between the plants in the rows must be wider than usual. At least 3 ft., or, better still, 3 ft. 6 in., should be allowed between the rows and 1 ft. 9 in. or 2 ft. from plant to plant in the rows. If these distances are not allowed, much fruit is trodden and

spoiled during picking, and Botrytis mould, due to lack of air circulation, may cause serious loss.

By combining the essential details mentioned in this article with the recognized best cultural methods, strawberry growing becomes less hazardous and more profitable.

The strawberry growing experiences of the author confirm these conclusions. In 1920, he purchased a purely agricultural farm in an area where no strawberries were grown, except in house gardens, within a radius of 5 or 6 miles. Runners were obtained from Warsash in the Southampton strawberry district from plants which appeared without exception to be extremely healthy. These runners must have been substantially virus free for they cropped heavily, as did three generations of runners from them. These runners were, of course, taken from the maiden fruiting plantations.

As runner production on this farm caused the fruiting plantations to become very foul with weeds, it was decided about 1925 to obtain plants for that year's planting from a source in Kent, reputed to be one of the best in that county. Undoubtedly this stock was heavily infected with virus, for notwithstanding constant rogueing the beds never cropped satisfactorily and new plantations made with runners from this stock were equally unsatisfactory.

About this time also, plants of Oberschlesien were obtained and planted near the original Warsash beds. These cropped exceedingly well at first, but in subsequent plantings the fruit crops successively deteriorated.

In an effort to revert to the original Warsash stock, potted runners were taken from selected older plants of this strain and planted to make a runner bed. Plants from this runner bed were good except in one piece and it was noticed that some of the runners in this portion of the runner bed exhibited yellow-edged deformed leaves which we now know as characteristic of Yellow Edge virus infection.

A fruiting plantation of these renewed Warsash runners was made in a field adjacent to the Kent Strain. This plantation cropped fairly well except in that area where the runners with Yellow Edge symptoms were planted. Runners from this plantation were taken in its maiden year, and these, together with a small number of Oberschlesien plants were planted on a new, purely agricultural farm which had been recently purchased some 1½ miles away. From then (about 1928) until

1937 no satisfactory crop of strawberries was obtained on either farm.

It would appear, therefore, that at this stage, the plantations on both farms were heavily virus infected and the outlook was hopeless.

In 1932, a few plants of the virus-free clonal stock recently produced at East Malling were obtained. These were planted in a separate field with about 600 yards isolation from any other strawberries. They were sprayed at regular intervals to reduce Aphis attack, but, in spite of this, a number of infections of Yellow Edge virus appeared.

In the following year, as the isolation of this bed was not considered satisfactory, runners were taken from only the strongest and most robust plants. These were planted in another field with an isolation of about 1 mile from any other beds. This runner bed has been carefully sprayed throughout its existence. It is now 5 years old and the plants even now are very large and dome-shaped. The bed is healthy except for several cases of severe Crinkle which have appeared this last year when the spraying programme has not been so careful as in previous years.

This isolated runner bed has been utilized to produce plants for planting two fruiting plantations. One, of two acres, was made in 1936 and the other of the same area this spring.

Prior to planting the 1936 fruiting bed, all the old fruiting beds on each farm were ploughed up and none was in existence for a year previously.

The fruiting plantation planted in 1936 has produced two crops of between 3 and 4 tons per acre in successive years, the individual fruit being of exceptional size. This fruiting bed, which is now commencing its third fruiting year remains remarkably clean and healthy for its age.

The new plantation planted this spring has done well, but this has exhibited a number of plants infected with severe Crinkle virus, though very few with Yellow Edge. It would appear that sufficient attention has not been paid to rogueing all forms of severe Crinkle in the runner beds.

The author is satisfied that prolific crops of strawberries can be obtained, given fair isolation: first, by ploughing up all the existing virus-infected plantations; next, by establishing an isolated runner bed of virus-free Royal Sovereign stock; finally, by planting the runners for this runner bed on land which has not grown strawberries previously and by keeping

each annual planting at least in a field other than those used in previous years.

Production of virus-free runners in isolated beds in the manner described entails considerable labour and expense in spraying and rogueing. In ordinary situations, however carefully the spraying and rogueing is carried out, there is always the risk of fresh infection by migrant aphides.

In an effort to overcome this danger, a runner bed has now been established at an altitude of about 1,000 ft. on moorland where there is a complete strawberry isolation of at least 5 miles and where climatic conditions are so severe that risk of aphis infection is almost negligible. During the past season, wind damage to the plants has been very serious, but with suitable shelter there seems no reason why strawberry runners should not be raised satisfactorily under these conditions. There can be no doubt that runners raised in this exposed situation and under such rigour will be the cleanest and healthiest it is possible to obtain.

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THE ROLE OF FOOD FAT IN NUTRITION

CHARLES CROWTHER,
Harper Adams Agricultural College

The problem regarding the specific part played by the oils or fats* of food in the nutrition of the animal has been the subject of investigation for many years, but still remains in many respects obscure, especially in so far as the application of scientific findings to farm practice is concerned.

The broad facts as to their concentration as sources of energy and their value for the production of animal fats in the body are familiar knowledge, but as to whether they are specifically required for these, or, indeed, for any other purposes, is less clearly established. Experiments and practical experience have demonstrated that nutritive results approaching the optimum can, under some conditions, be obtained with rations containing proportions of oil that, judged by common farm feeding practice, must be regarded as extremely low. In one of my own experiments, for example, a group of pigs on a ration containing not more than 1 per cent. of digestible oil gave just as good growth and carcass quality as a similar group on a ration supplying fully 50 per cent. more digestible oil. A similarly favourable result was obtained in American experiments with a diet containing as little even as 0.5 per cent. of fat.

That there is a minimum fat-requirement, for the rat at any rate, was demonstrated some ten years ago in American experiments, in which it was found that rats placed upon diets almost entirely devoid of fats developed a scaly condition of the skin, failed to grow and soon died. Adult rats on the same diet soon lost the power of reproduction. In each instance normal conditions were rapidly restored when a small quantity of an appropriate type (unsaturated) of oil or fatty acid was added to the diet. There is also evidence that on a low-fat diet the requirement for vitamin B may be increased, and the efficiency of utilization of the carbohydrates of the diet lowered.

In all these experiments which appear to have shown a specific requirement for fat in the food, the amounts of fat in the diets have, however, been reduced to a point so far

* The terms "oil" and "fat," as here used may be regarded as synonymous. Oil is the liquid, fat the solid form.

below any proportion that could be attained by the use of the ordinary foods of the farm that we can practically rule out any risk of shortage of fat in our farm rations serious enough to cause actual injury to the animals.

What for practical purposes is more important to know than the existence of a minimum requirement for fat is whether there is an optimum level of supply, and if so where that lies for the different classes of live stock.

On this point, the evidence, except as regards the milch cow, is unfortunately very meagre, and the subject deserves more attention from investigators than it has hitherto received. The relative richness in fat of the milks of all species raises the presumption that for the early life of the mammal at any rate there is some specific virtue in a high level of fat supply. The same may also be deduced regarding the chicken from the richness of the egg yolk in fat. This "specific virtue" may, however, amount to no more than the familiar high concentration of energy in the fat. Whatever the real explanation, it is certain that any specific need for fat subsequently diminishes very rapidly to the level represented by the ration with 4-5 per cent. of fat.

That the level of fat supply to the growing pig is apparently of minor importance has already been noted, and this may be regarded as a fortunate circumstance, since for other reasons to be discussed later it is desirable that the oil content of pig rations should be kept low.

The requirements of the suckling sow may be different, since there is a certain amount of evidence from work with other lactating animals that the processes of milk-secretion may be influenced by the supply of digestible fat in the diet. This evidence, which has mainly been obtained in studies with cows, sheep and goats, indicates that, under some conditions that cannot be precisely defined, changes in the fat supply in the food are accompanied by changes in the amount of milk secreted; with sometimes a specific effect upon the secretion of milk-fat, resulting in a rise or fall of the percentage of fat in the milk.

Thus, in experiments with cows at the Cornell Experiment Station, the removal of most of the fat from a ration and its replacement by a quantity of starch supplying the same amount of nutritive energy caused a reduction of the milk yield, but no certain effect on the fat percentage. In these experiments the normal ration contained 5.8 per cent. of fat, which was

reduced by the extraction of fat and substitution of starch to 0.66 per cent.—clearly a range of difference that is unlikely to arise in farm practice. The amount of fat supplied in the fat-poor ration in these experiments was in fact less than the amount of fat secreted in the milk. In other experiments at Cornell, in which the fat supply in the ration was not reduced below the amount secreted in the milk, the effects on the milk yield were more uncertain and erratic. This raises the interesting suggestion that, possibly, the relation of the amount of fat in the milk to that in the food supply is the decisive factor that determines the effect, if any, of changes in the fat content of the ration upon the milk secretion. There is good reason to believe that the production of animal fat from carbohydrates is a more complicated process than that from food fats. It may be, therefore, that when the supply of food fat is very scanty the animal organism, working at full capacity, is unable to manufacture as much product, being called upon to perform the more arduous task of converting carbohydrate into fat, as if a greater proportion of it were coming more easily from an increased supply of food fat.

It will be noted that in these experiments the effect was restricted to the total yield of milk and did not result in any change in the percentage of fat in the milk. Efforts to influence the latter have almost invariably failed, but in the great mass of experimental reports on the subject there are occasional records of positive results which appear to be valid on critical analysis. The tendency of cod-liver oil to lower the percentage of fat in milk is a case in point, whilst the opposite tendency exercised by palm-kernel and coconut oils seems also to be adequately demonstrated by Continental experiments and experience. Apart from a few exception such as these, however, the main body of experience recorded suggests that a measurable specific influence of the food fat in increasing the secretion of milk fat is only obtained when the fat supply is well above the upper limits of common farm practice, and, further, that it is dependent upon the chemical character of the food fat.

Thus, in experiments reported from the University of Minnesota definite increases in the fat content of milk were produced over short periods by additions of large amounts (1¼-2 lb. daily) of butter-fat, lard, tallow, and the oils of linseed, cotton-seed, maize, ground-nut, soya beans and coconut to the rations of dairy cows. Tests along similar lines

in Ireland failed to give confirmation, but this has been supplied in more recent tests at Cambridge, which are reported in the current issue of the *Journal of Agricultural Science*. In these tests, in which amounts of oil varying from ½ to 1½ lb. per day were added to normal rations, butter, lard, palm oil and, possibly, cottonseed oil were found to increase butter-fat yield, chiefly by raising the fat percentage of the milk. Soya-bean, linseed and whale oils were without effect. Cod-liver oil definitely decreased butter fat percentage and butterfat yield. It is remarked, however, that "experiments with the same oil were not always consistent and it appears that the effect may vary from cow to cow, and also with the same cow at different times."

One interesting feature of the Cambridge observations is that the oils which produced favourable results were in one respect markedly different in their chemical make-up from the oils that proved ineffective. Oils (and fats) are chemical combinations of glycerine with a variety of acids, designated as a group—the "fatty acids." These acids are divided by the chemist into the two groups of the saturated fatty acids and the unsaturated fatty acids. In butter-fat about two-thirds of the acids belong to the saturated group, and it would appear significant, therefore, that all the oils that gave positive effects in the Cambridge tests have much higher proportions of saturated acids in their fatty acids than the other oils tested. This may perhaps explain why palm-kernel and coconut meals in some instances may increase the fat-content of milk whilst linseed and soya meals do not.

The subject clearly needs further investigation, and in the meantime one cannot prescribe with confidence any enrichment of the cow's ration in oil beyond the level necessary to ensure that the total ration supplies digestible oil not seriously less in amount than that of the fat in the milk secreted. This will generally be assured if the concentrate mixture used contains 4-5 per cent. of fat.

More clear than the evidence as to the effect of food fat upon the quantity of animal fat produced is that as to its influence upon the character of the latter. It is broadly true to say that the food fat tends to impress its general character upon the body fat, milk fat, and even the fat of the egg. This particular effect is notably associated with the unsaturated acids, some of which seem to pass with little change into the body fats.

Fats rich in unsaturated acids are invariably soft in character, and often actually liquid at ordinary temperatures. Such fats (or oils) in the food will, therefore, almost certainly have a softening tendency upon the body fat or butter-fat, a property that may constitute an advantage or disadvantage according to circumstances. In the production of beef or mutton, for example, where the natural fat may easily become too hard, the inclusion of food with softening oil may ensure a better-textured fat. In butter-making, a softening effect of the food will commonly mean an advantage in the winter, but a disadvantage in the summer.

In the production of pig fat, on the other hand, where the feeder's problem is to get the fat firm enough, it is obviously desirable to restrict the use of foods with softening oils as much as possible. The problem in its application to meat production (see this JOURNAL, Vol. XLIII [1936-37], p. 485) is thus clearly one of considerable interest and importance, especially in connexion with bacon production. It is complicated by the fact that the fat in the carcass is of two types, which we may describe roughly as "constitutional" fat and "reserve" fat respectively. The former represents the fat distributed throughout the body tissues, which is essential for the healthy development of the animal, as distinct from the "reserve" fat, which, as its description implies, is a surplus product stored up under the skin and round some of the organs, which will serve if required to tide the animal over temporary shortages of food.

The "constitutional" fat has a texture which under normal conditions is characteristic of the particular class of animal, but varies at different stages of growth and also with different rates of growth. Thus, in the newly-born pig, the fat, which at this stage is mostly "constitutional," is relatively firm, but tends to become softer during suckling (possibly the effect of the sow's milk-fat) and subsequently firmer again. Restricted feeding, or any other factor tending to slow down the growth rate, will tend to retard this post-weaning hardening tendency. Where the rate of growth is deliberately restricted, therefore, it is all the more important to keep down the proportion of softening oils in the ration. The same applies also where growth is retarded by cold conditions. Fat produced in winter tends to be softer than that given on the same diets in summer.

As long as the animal receives more food than it requires

for the purposes of maintenance and growth it will store up part of the surplus in the form of fat. This fat comes partly, and perhaps most readily, from the oil of the food, but in the main from the surplus carbohydrates and proteins. The former fraction of the fat tends to be soft and the latter hard. The texture of the fatty tissues as a whole will thus vary according to the proportions of these two fractions. By increasing the oil content of the food and reducing the food supply the proportion of soft to hard body-fat laid down will be increased and the whole fat deposit will be softer; by reducing the oil content of the food and feeding more liberally with starchy foods, the amount of soft fat laid down will be reduced and that of hard fat increased. Similarly, where other conditions, such as low temperature, tend to slow down the rate of growth, a less oily ration should be used than may be suitable for conditions of more rapid growth.

Whether a particular oil will have a softening or hardening tendency upon the body-fat depends (as found above with regard to butter-fat) in great measure upon the extent to which the balance of saturated to unsaturated acids in it approaches to that found in the normal body-fat of the animal.

The oils of most of the foods used for the pig are richer in unsaturated acids than normal pig fat, and consequently are softening in their effects. This applies to the oils of cereals and cereal by-products, fish meal, cod-liver oil, soya meal and linseed. The oils of coconut and palm kernel meals on the other hand are less unsaturated, and therefore less open to objection in this respect.

SOIL TYPES AND CROP PERFORMANCE

F. Hanley and W. Morley Davies

It is common experience amongst farmers that fields on which the surface soils are apparently almost identical may crop very differently. The reason for this may be a very simple one, e.g., the soil on one field may be acid and on the other well limed, or there may have been a marked difference in the past manuring of the fields, but sometimes no such simple explanation is forthcoming and it is only when the soils are examined to a depth of two or three feet that a reason for the differences in cropping is eventually discovered.

To confine an examination of the soil to the top layers only, therefore, may fail to disclose some important feature that may limit crop growth. For this reason the unit of study now generally adopted in the classification of soils* is the soil profile, i.e., the characteristic features exhibited in a vertical section of the soil, since these reflect, in the various horizons or layers, the more important properties as well as the past history of the soil and the changes which it has undergone in the course of its evolution.

The soil profile is best studied in the side of a hole dug in the ground. The points most commonly considered in examining a profile are the texture, colour, stoniness, water relationships, structure and degree of compaction of the various horizons or layers into which the section can naturally be divided. At the same time, the lime status may be examined, but this is not regarded as a permanent characteristic of soil type. On the other hand, liability to acidity, or the need for periodic liming may be considered a more permanent feature, though crop performance may differ on two fields of the same soil type if one is acid and the other has recently been limed. The soil profile is usually examined to the depth at which the unweathered parent material is encountered, or, where this is very deep, to a depth of about three to four feet. Other factors, such as drainage conditions, topography, geology, and type of parent material from which the soil has been derived, are also taken into consideration in assigning a soil to any particular group or soil series.

When an area has been surveyed in this way a map can be

* For a full account of methods used in soil survey work the reader should consult the literature already published, and summarized in *The Study of the Soil in the Field*, by G. R. Clarke, published by the Oxford University Press.

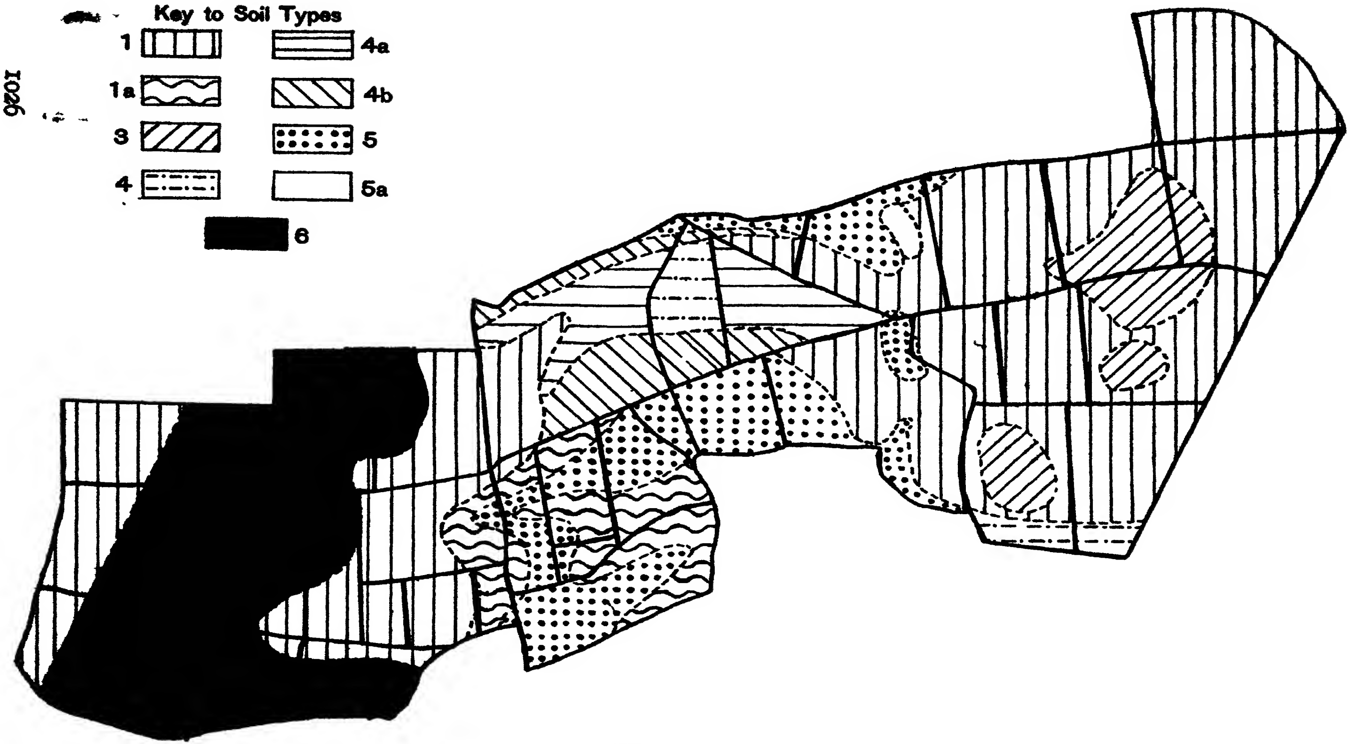
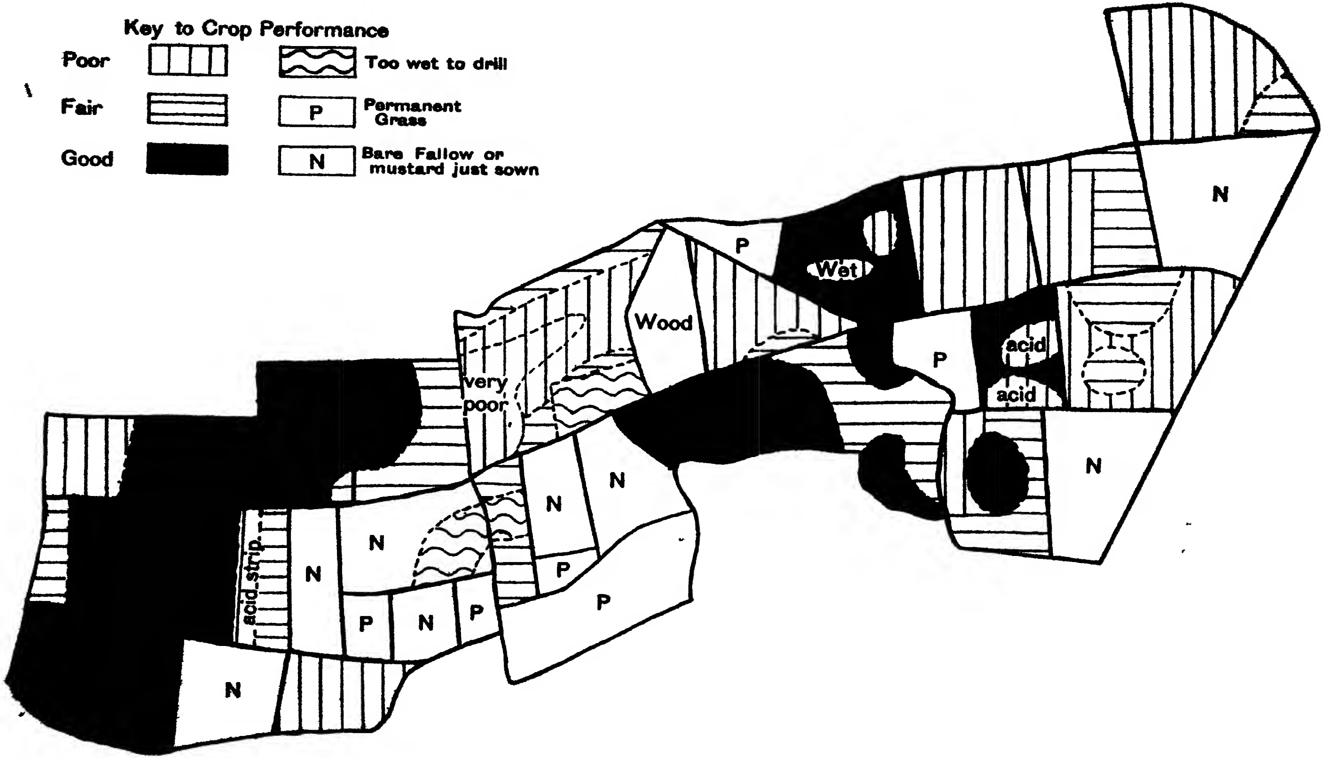


FIG. 1.—Distribution of Soil Types.



Key to Crop Performance
Poor
Fair
Good
Too wet to drill
P
Permanent Grass
N
Bare Fallow or mustard just sown
N
P
Wet
acid
acid
Wood
very poor
acid strip

constructed showing the location of the various soil types, so that, by reference to the description of the characteristic features of each soil series it is possible to obtain a picture of the soil conditions on any field in the area and to forecast the probable performance of crops grown thereon.

It should be emphasized that a map based on this system of soil survey gives far more information than one based on an examination of the top soil alone. As will be shown later in this article, seemingly identical top soils may crop very differently if the layers below them are of varying character. In other words, the cropping capabilities of a field cannot be properly judged by an examination of the surface soil alone. It is essential, therefore, that the lower layers also should be examined to such depth (usually three to four feet) as is likely to influence growing crops.

In April, 1937, a number of soil surveyors made a detailed field-to-field survey of an area of approximately one square mile in the east of the County of Suffolk. The method of surveying was according to the system now generally used by soil surveyors in this country. In view of the general interest in the question of soil surveys the Soil Surveyors' Conference subsequently invited the authors to prepare and publish an account of this survey, since, as will be seen later, the results illustrate the close connexion between soil types, as distinguished in the course of properly conducted surveys, and the performance of crops growing on them.

The particular area dealt with in this article was chosen as likely to include a number of soil types differing in varying degree from one another. Map I shows the distribution of nine soil types as found in this survey.

The winter and spring of 1936-37 were very wet and since a good deal of the area had recently been in a poor state of cultivation very few fields carried a crop when the survey was made. In order to ascertain, therefore, whether differences between soil types, as determined by the soil surveyors, would really influence the growth of crops, one of the writers visited the area again just before the cereal crops were harvested, and also at the end of September to inspect the root crops. Observations on the growth of the crops in each field were recorded on a map (Map II). If Maps I and II are compared, the close relation between soil type and crop performance is immediately obvious, despite the fact that, as already stated, much of the area was bare of crops when the

survey was made. It is not proposed to make a detailed comparison of soil type and crop performance in this article, but the following examples serve to illustrate the close relation between them.

The top soil over most of the area was light in texture, but some of the soil types, e.g., 1*a* and 5, exhibited symptoms characteristic of impeded drainage, and under certain climatic and topographical conditions this feature would be expected to dominate to a large extent the performance of crops growing on these soils. As already mentioned, the winter and spring prior to the survey were abnormally wet, but were followed by a very dry summer. Such a sequence of climatic conditions would naturally lead to difficulties in the preparation of spring seed-beds, particularly on badly water-impeded soils. On the other hand, in the dry summer months, crops might be expected to benefit by slight hindrance in natural drainage or impedance in such soils, provided that waterlogging in the spring was not severe enough to interfere with the sowing of the crop. These expectations, based on a study of the soil profile, were fully justified, for, when the arable crops were inspected in the late summer, it was found that soil type 1*a*, which showed marked symptoms of badly impeded drainage, often combined with a flat or depressed topographical situation, had proved impossible to crop during the spring and early summer. Most of the arable land on this soil type was too wet to work down into a seedbed for spring-sown crops, whilst in a field intended for bare fallow, a strip of land left uncultivated because it was too wet to plough when the rest of the field was done in late spring, was found to coincide exactly with a strip of soil type 1*a* shown on the soil survey map. Soil type 5, on the other hand, was also described by the surveyors as showing signs of impeded drainage, but only below a depth of 18 in. Most of the crops on this soil type were quite satisfactory. The slight impedance in the lower layers of the soil was rarely sufficient to prevent the preparation of a satisfactory seedbed and apparently benefited rather than restricted subsequent crop growth in such a dry summer on land that had been caught dry enough to work and drill in the spring. The only unsatisfactory crop on this soil type was a rather thin " plant " of sugar-beet on part of a field lying towards the bottom of a slope and in a situation, therefore, where even slight drainage impedance might have been expected to lead to difficulty in the prepara-

tion of a satisfactory seedbed during a wet spring. Though this unsatisfactory area was only a relatively small proportion of that occupied by soil type 5 it served to justify the recording, by the soil surveyors, of the existence of some drainage impedance on this type, thereby differentiating it from others, such as type 1, which though similar to type 5 in many ways, were undoubtedly free draining and never likely to suffer from excessive wetness. It should be noted, however, that the liability of type 5 to suffer from wetness *was not evident from an examination of the upper layers of soil, but was only observed when the layers below 18 in. deep were examined.*

In contrast with types 1*a* and 5, characterized by impeded drainage, were other types in which drainage was obviously likely to prove excessive, e.g., type 1. Examination of the surface soil of type 1 *by merely walking over the land* or studying only the top spit did not reveal any marked differences between this type and number 5, *but examination of the lower layers led to its being placed in an entirely different category,* for number 1 showed only coarse, open sand to the full depth of the profile, whilst number 5, as already mentioned, showed some drainage impedance below 18 in. Number 1 was therefore classed as a soil which would suffer from excessively free drainage in a dry season. This was borne out by the crops, for in the dry summer following the survey all crops on type 1 were short and stunted, suffering severely from drought, and were much inferior to those on type 5. *Thus a difference in cropping capacity that could not possibly be foretold from an examination of the top 12-18 in. of soil was made apparent by a proper examination of the full soil profile.*

It is also instructive to compare types 3, 4*a* and 6. These again were all very similar top soils but not quite so light in texture as types 1 and 5. All three carried better crops than type 1 due to their rather greater powers of holding moisture and nutrients, a result which could be foretold from their slightly heavier texture. Crops on type 4*a*, however, though a little better than type 1, were not nearly so good as on types 3 and 6. *The reason for this was again to be found in the lower horizons of the profile,* for whilst the texture of 4*a* remained uniform throughout its depth, types 3 and 6 both changed gradually to a considerably heavier material at about 30 in. deep. This, though not heavy enough to cause serious drainage impedance, served to improve the moisture supply to crops.

Comparison of types 5 and 4*a* shows that, despite a lighter sandy top soil, type 5 cropped better than type 4*a*. The explanation is again to be found in the greater moisture retentivity in the lower horizons of type 5, apparently more than compensating for the very sandy nature of the top soil.

In the season 1937, therefore, variations in crop performance over the area surveyed, whether on the same or on different fields, were very closely related to the variations in soil types distinguished in the course of the soil survey. This agreement between the characters of the soils differentiated and the later survey of crop performance thereon was probably accentuated by the weather conditions in 1937. This was only to be expected, since one of the most marked differences between the soils of the area was the extent to which their natural drainage conditions varied. The soil survey undoubtedly provided an entirely satisfactory explanation of some very striking differences in crop growth.

Although an observant farmer, new to the area, would in the course of years realize the potentialities and major cropping difficulties of many of the fields, access to the findings of a soil survey of the area, would undoubtedly enable him to foresee, and possibly take steps to overcome, some of the difficulties from the very outset of his tenancy.

While it is outside the scope of this article to describe each soil type on the area, for the benefit of readers who are unacquainted with the modern survey system, the following example—soil type 5—is given.

DESCRIPTION OF SOIL TYPE 5

Parent Material	Sand, noncalcareous, yellow; over silt clay
Geology	Sandy wash over Chillesford Clay.
Topography	Flat to gentle slope.
Drainage	Impeded below 18 in.
Vegetation	Barley.
0–7 in.	Brownish-grey coarse sand; occasional stones.
7–14 „	Grey coarse sand with brown mottling; moderately compact.
14–22 „	Bluish-grey coarse sand. Bleaching due to drainage impedance.
22–25 „	Bluish-grey coarse sand with many rusty patches.
Below 25 „	Blue and orange mottled clay with black specks, passing into raw clay.

BARLEY GROWING IN MECHANIZED FARMING*

W. D. Hollis,
Leckford Estate, Hants.

Barley to the mechanized farmer is a most important crop. Many of our large mechanized farms have a considerable proportion of light soil, suitable for barley growing, and even on heavier soils barley can be very well taken as a second or third white straw crop. Then again, the growing of this crop spreads our sowing and our harvesting activities over a longer period than if oats and wheat only were grown.

The place in rotation for barley at Leckford is generally after wheat or oats on the better soil, and after barley, fallow, or sheep folded on the light soil. It may be a matter of surprise that in our mechanized activities we find a place for sheep. We still keep three flocks of ewes and fat out the tegs.

The land is well ploughed (about 5 in.) in the autumn, except of course behind the sheep, when the first ploughing is as shallow as possible. The second ploughing takes place in the New Year about a fortnight or three weeks before the field is to be sown. As a rule, for this second ploughing a disc plough of the polydisc type is used, which on most soils leaves a beautiful seedbed that only requires a light harrowing to be ready for the drill. After sheep, however, we generally use a mold board plough, and, of course, cross the previous work.

I remember once, when farming in Norfolk on very light land indeed, getting a quite remarkable crop of barley behind sheep folded on roots, and the plough was never used; the cultivator was kept going close behind the fold and, after the sheep had moved off, the field was cultivated twice more, broad shares being used the last time. The crop was a good one and clean. I think there is a danger on light land in ploughing the sheep droppings in too deep, so that with a heavy rainfall much of the goodness is washed down out of reach of the barley roots.

We generally like to start sowing about the middle of March; and for yield and quality, in my experience, from March 10 onward is about as good a time as any. I am referring of

* This article consists of a paper read at the Rothamsted Barley Conference on November 29, 1938.

course to light land. We have tried winter sowing, but so far without success.

I believe in dressing the seed with one of the powder dressings, and the usual rate of sowing is 3 bushels to the acre. We grow Plumage Archer, 1935, on the better soil and Golden Archer, Spratt Archer and New Cross on the light land. The rather heavy dressing of seed is due to the frequent attacks of wireworms, which in our particular district are very prevalent. Were it not for this pest, I should reduce the rate of sowing to probably 10 pecks per acre. In the past, we have been sowing manure and seed separately, but have now introduced combined drills, and so far it looks as if this method will reduce our risks of loss from this trouble.

We use a compound manure specially mixed, containing 4 per cent. nitrogen, 8 per cent. phosphoric acid and 5 per cent. potash, applied at time of sowing. The potash is most important on our light soils and we always put it on in the form of kainit. There has been a good deal of controversy from time to time as to the advisability of using inorganic nitrogen for barley, but, if applied at the time of sowing in reason, I think it is beneficial. If, however, it is applied later as a top dressing I think it has a tendency to make the sample steely.

I am very strongly of the opinion that there is a real danger when drilling with disc drills, particularly on light land, of getting the seed too deeply, and I still think the ideal coulter for barley is the old shoe type. I have seen many crops of barley with a nasty yellow tinge when the plant first comes through and when examined the seed is found to be buried 3-4 in. deep. I have frequently had to roll before the drill to obviate this.

The chief curse on our light land after the insatiable wireworm is charlock, and I think I would back our district against almost any other in this country for growing this "yellow peril." We find that light harrowing before the barley comes through, followed a day or two after by a good rolling, is a pretty good method of eradicating this weed. We watch the barley carefully and when we find that the seed has just shot, harrow with light harrows. If the barley has shot then so has the charlock, and if you follow the harrow you will see the white hair-like shoots of the charlock on the surface of the soil. I do not say that this can be done on all lands. You must watch your job very carefully indeed; the

condition of the soil must be dry and fine and the harrows must be light. Wet weather will, of course, entirely defeat this operation.

After the charlock has once got established, it is far more difficult to move with a harrow, and then spraying with sulphuric acid is the only course to pursue. We find that spraying with sulphuric acid on chalk soil not only kills the weed but also increases the crop. On spring wheat we have had some really remarkable results and the matter is well worth further investigation; there are several theories as to what the action is but I don't think anyone is clear on the point.

When the barley is nicely up, we roll, sometimes two or three times. This is on very light land; I should not advocate such a procedure on the heavier soils.

Then, all you can do until harvest time is to pray for reasonable and seasonable showers. This last season we had 0.6 in. of rain in 91 days. Our barley crops were not very good in consequence, although they withstood the drought better than one might expect.

Then to harvesting. Far too much barley is cut before it is properly ripe. It is, I know, a great temptation to put the combine in and get on with the job, but it is better to lose a few ears on the ground than to spoil a good sample.

In combining, as in other threshing, great care must be taken in setting the drum and also in regulating the wind. It is very sad still to see so many samples of barley on the market badly knocked about through the machine being set too close, and unless the wind is carefully regulated on a combine you are apt to get considerable loss over the riddles. It is essential to keep all the riddles as clear as possible.

After combining, the barley is brought to the drier, and put through a simple winnower. It is then elevated to the top of the drier, which is always kept full, and as the corn slowly sinks it meets first of all a current of hot air (never over 100°F.) and then cold air. It is then elevated again and passes through a large dressing machine to be thoroughly screened and is then conveyed to bins.

A moisture test is taken when the barley first comes in and also when it goes to the bins after drying. Anything under 15 per cent. we consider pretty safe. If the moisture content is still above 15 per cent. we take the first opportunity to pass the grain through the drier again.

All our bins are ventilated at the bottom to allow for the

escape of CO_2, and the temperature of the corn is taken twice every day for a time to see that no heating occurs.

Barley will always sweat in a bin, and sometimes, particularly if there is a sudden change from dry to wet weather, you may get a sudden rise in temperature. We consider that if the temperature of a bin rises above the atmospheric temperature by 5 degrees, it is advisable to turn the corn, or at any rate "to have the middle out."

To take the temperature of the corn we have a 1½-in. pipe which has one end pointed and in which numerous small holes have been drilled for about 3 ft. from the point. We push this down into the middle of the grain in the bin and then pass a thermometer down on the end of a wire and plug the end. By this means we can keep a thorough check on our corn and know what is going on. In any event, we usually turn the bin once or twice. When the barley has been stored for about a month it is once more put through the dresser before being sold. In fact, this may seem a rather expensive process, but it is not so. We can turn 25 sacks per hour at a cost of about 1½*d*. per sack.

A word of warning, especially to combine users. I believe that corn weevil in this country is on the increase. This pest usually comes over in imported food from warm climates. So, if you use bags from a pig farm or poultry farm, look out, and suspect anything coming from where you know foreign-grown food has been used. For, if you get weevil into your bins it is going to be extremely difficult to eradicate it.

These are the methods we use at Leckford, but they will not, I know, suit all districts and can probably be improved on in ours. The great aim must be to get the crop as even as possible in germination, growth and ripening, and this can only be accomplished by good cultivations, even manuring, and last, but not least, the best of all manure—the foot of the farmer.

NOTE: In the discussion which took place on Mr. Hollis's paper at the Rothamsted Barley Conference three points of general interest were raised, which are briefly summarized in the following note:—

TIME OF SPRING SOWING. For his light land conditions, Mr. Hollis stated that March 10 was about the time to start sowing. Most other speakers favoured early sowing, which they believed was associated with high quality. Actually, it

appeared that barley should be sown as soon as a really satisfactory seedbed could be produced in spring. This depends greatly on the season, as an examination of recent records derived from these Conferences showed.

PERCENTAGE OF TOTAL SPRING SOWINGS MADE IN:

	February	1st Half March	2nd Half March	1st Half April	2nd Half April
1936 ..	5	25	46	19	5
1937 ..	3	8	16	41	52
1938 ..	41	42	14	3	—

Only in 1938 was February sowing at all frequent. In the two previous seasons, sowings made in the first half of March would have passed as early sowings.

AUTUMN SOWING. At Leckford, autumn sowing had not been successful. The barley started well but went off in spring. In amplifying this point Mr. Hollis mentioned that the barley had been sown in September. In view of experience in Essex it was likely that better results might follow later sowing, for there appeared to be no advantage in sowing before November. Apart from time of sowing, winter barley was said to be best in the drier and less exposed districts.

SULPHURIC ACID SPRAYING. The use of this spray against charlock had produced such marked benefit to the growth of the barley that Mr. Hollis was inclined to believe that some special action on the soil was involved. This point was discussed by several speakers, and their conclusions were that the removal of weed competition might account for the benefit observed. The release of available nutrients from the soil by the acid, while not excluded, was thought to be unlikely on highly calcareous land. The point seemed of sufficient interest to call for experimental study,

MALTING BARLEY: CONFERENCE AT ROTHAMSTED

H. V. GARNER,
Rothamsted Experimental Station

The fifth, and perhaps the most successful, of the Rothamsted Conferences on Malting Barley was held in Harpenden on November 29 under the Chairmanship of the Right Hon. The Earl of Radnor. In addition to the customary inspection of a number of barley samples graded by the Valuation Committee of the Institute of Brewing, several interesting papers were read by practical farmers on various aspects of barley cultivation.* A general discussion followed in which several well-known people in the barley world took part. It is not possible within the compass of a short note to do justice to the papers, but an attempt may be made to collect some of the more important points that were discussed.

The grading of the 240 samples was carried out according to market prices, and eight classes were distinguished, the first three being pale ale barleys, the next four being suitable for mild ale, while the last failed to reach malting standard. The figures, classified by districts were:—

Grade	Norf.	Suff.	Esx.	Lincs, Yorks, Notts	East Mids.	Kent	West	South	TOTAL	%
I ..	0	0	0	0	0	0	0	0	0	0
II ..	0	1	0	0	0	8	0	0	9	4
III ..	1	3	1	0	1	4	1	1	12	6
IV ..	3	4	2	0	2	3	1	1	16	7
V ..	15	9	3	2	6	3	7	13	58	27
VIa ..	8	9	2	15	7	3	11	11	66	31
VIb ..	6	4	1	16	4	0	1	8	40	19
VII ..	2	2	1	2	2	0	2	2	13	6
TOTAL	35	32	10	35	22	21	23	36	214	—
MEAN GRADE	5·5	5·2	5·2	6·2	5·6	3·5	5·6	5·7	—	—

East Mids. = Cambs, Herts, Beds, Oxford.
South = Wilts, Dorset, Hants, Sussex, Berks.
West = Hereford, Shropshire, Warwick, Worcester, Somerset.

* That by Mr. W. D. Hollis on *Barley Growing in Mechanised Farming*, and a summary of the ensuing discussion, are printed on pp. 1032–1036 of this issue.

There were no Grade I samples, and only 9 in Grade II; 58 per cent. of the total fall in Grades V and VIa, that is, about the middle of the mild ale group. Kent, as usual, sent in samples well above the average, while the Lincolnshire samples were rather below it. Examination of the effect of time of sowing showed the superiority of autumn-sown samples but not quite to the same extent as in former years. Within the spring section, however, there was a well-marked decline in quality with delayed sowing. Thus, there was an average loss of nearly a grade and a half between samples sown in February and those sown in the first half of April. The average yield of the fields from which the samples were drawn was no less than 5.6 cwt. per acre higher in 1938 than in 1937, and to this increase in yield was attributed, in part at any rate, the present disastrous prices of good malting barleys. The excellent performance of the 1938 barleys in the malt house was testified by competent authorities in the trade.

In his interesting comments on the grading of the samples, Mr. H. M. Lancaster once again stated that it was difficult to justify the big span in market values of malting barleys in terms of their intrinsic values as malting material. Thanks to modern varieties, which showed a great improvement on the old sorts in yield and quality, especially when grown in an unfavourable season, there was frequently a glut of good malting material and the problem was how to secure a remunerative price for it.

Farmers had been invited to send in pairs of samples, one good and the other inferior, and to assign reasons for the difference observed. The reasons most frequently put forward were (1) too much nitrogen in the soil from the residues of previous organic manuring, (2) late spring sowing, and (3) bad tilth. The second two points were repeatedly taken up by growers who had experienced similar troubles in the past droughty season.

On the cultivation side, speakers agreed that fineness, uniformity and compactness of the seedbed and freedom from annual weeds were the main requirements for spring-sown barley. This view was not seriously shaken by the instances reported in which sowing in a rough seedbed had occasionally given satisfactory results. On the other hand autumn-sown barley need not have a particularly fine tilth, clods in fact acted as a protection in winter provided there was mould below. The impor-

tant condition in regard to the seedbed for winter barley was that it should be dry. Light rainfall and a warm exposure were vital points for this crop.

All three principal speakers advocated a moderate dose of nitrogen for barley grown as the second corn crop. An examination of the records submitted by farmers showed that this practice is now widely adopted. Thus, of 202 records examined, 123 showed that nitrogenous artificials had been used to the barley, in 77 instances as part of a mixture of artificials. The average dose was about 20 lb. N. per acre, or rather less than 1 cwt. of sulphate of ammonia. After sheeping or green manuring (beet tops, leys) extra nitrogen was much less frequently applied. Late top-dressing and excessive organic manuring were condemned, and, as recent investigations show, with good reason. Methods of combating annual weeds by well-timed light cultivation during the preparation of the seedbed, and again when the seed was just chitted but not yet through the ground, were described and discussed. Mechanical methods had clearly given growers much greater command over their cultivations, enabling the best to be made of the all-too-brief periods when the land is working with the farmer.

Farmers and maltsters alike testified to the excellence of the two popular varieties Plumage Archer and Spratt Archer. Their producers, Dr. Beaven and Dr. Hunter, were both present and dealt with points in connexion with the choice and treatment of seed for sowing.

The performance of strains depended very much on soil conditions, and when farmers had found a stock of seed that suited their land they were strongly advised to stick to it.

ITALIAN AGRICULTURE

CESARE LONGOBARDI,
International Institute of Agriculture

Physical Environment. The physical conditions under which farming is carried on in Italy vary very greatly, as do also the methods used, so that even within the limits of a single province the most diverse systems are applied and the characteristic features and the results secured differ widely.

The mountainous and hilly character of Italy and the fact that, starting from the high range of the Alps, the country stretches southwards into the sea accounts for the great variety of climatic conditions, ranging from those found in northern countries to those of southern Europe, and of the Mediterranean coasts of Africa.

Geological and pedological conditions are also very varied, and much of the finest land is the result of the incessant toil of past generations; thus rich, porous soil now covers former gravel beds, rocky mountain-sides have been converted into fertile terraces, and sandy wastes along the sea-shore have been transformed into market gardens.

If, on the one hand, Italy enjoys abundant sunlight, on the other, her water supply is often poor. While the valley of the Po and the adjoining territory is generally well watered by rains, streams, or springs fed by the Alpine snows and glaciers, other zones are not only sub-arid, but suffer from the fact that the rainfall is heaviest in the autumn and winter and scanty in the spring and summer when most needed by the crops.

Population. On December 31, 1937, the population of Italy was officially estimated at 43,504,000 inhabitants, and the density at 363.4 per sq. mile. According to the 1936 census, 45.3 per cent. of the population belonged to families having a farmer at their head, and 47.7 per cent. over 10 years of age were occupied in agriculture. In North Italy the percentage engaged in agriculture was 41.8; in Central Italy it rose to 50.4; in the Islands to 51.1, and in the South to 58.3.

In Italy, as elsewhere, the percentage of the total population classified as rural tends to decline, but the decline is so gradual as to be almost imperceptible.

TABLE I.—ARABLE CROPS (AGRICULTURAL SURVEY, 1929) *

	Integral † Area 1929		Repeats ‡ Area 1929	Production		
				Total 1929	Per Acre 1929	Yield 1937*
	Acres (000's omitted)	%	Acres (000's omitted)	million lb.	lb. per acre	lb. per acre
Cereals	16,496	52·3	1,225	—	—	—
Wheat	11,061	35·1	595	14,701	1,261	1,392
Spring Maize	3,152	10·0	99	5,222	1,606	2,141
Summer ,,	—	—	310	341	1,102	1,651
Rice (rough)	343	1·1	25	1,603	4,355	4,568
Leguminous Crops for Grain	2,126	6·8	1,678	—	—	—
Potatoes	819	2·6	223	6,216	5,969	6,789
Arable Forage Crops §	5,690	18·1	2,985	33,102	—	—
Rotation meadows §	5,173	16·4	1,538	28,078	4,184	4,782
Annual grass crops §	517	1·6	156	1,829	2,720	3,372
Catch grass crops §	—	—	1,291	3,195	2,472	3,176
Industrial Crops and Flowers	670	2 1	198	—	—	—
Fresh Vegetable Crops	353	1·1	337	—	—	—
Tomatoes	126	0·4	33	2,788	17,579	15,791
Green pod vegetables (peas, broad beans, etc)	38	0 12	39	285	3,693	—
Kitchen Gardens	89	0·3	6	—	—	—
Crops for Seed	9	0·03	-	—	—	—
Other Crops	1	0·003	- -	-	- -	.
Fallow Land	2,967	9·4			—	. .
Other Areas ‖	2,294	7·3	—	—	—	—
Total	31,514	100·0	—	-	—	—

* The figures for per acre yield in 1937 are taken from the Annual Statistics (see *Boll di Statistica agraria e forestale*, June, 1938)

† " Integral " areas are those occupied during the major part of the crop-year by one crop alone or associated with other secondary crops

‡ " Repeat " areas are those occupied by a crop grown in succession with others on the same area and during the same crop-year, but which do not occupy the land for the major part of the crop-year, or which grown in association with other crops occupy the land for the major part of the crop-year but are not the principal crop.

§ Yield expressed in hay.

‖ " Other Areas " are the small areas occupied by ditches, farm roads, walls, hedges, etc.

In studying agricultural conditions the mountainous nature of the country must always be borne in mind. The importance of this factor is indicated by the fact that no less than 13.5 per cent. of the population dwell in communes situated at altitudes varying from 1,642 ft. to 3,300 ft. and more.

Agricultural and Forest Area. Italy covers an area of 76,624,000 acres, of which 6,102,000 are classified as unproductive, being occupied by inland waters, towns, roads, etc., or consisting of bare rock, glaciers, eternal snows, gravel beds, sandbanks, and sea-shore. The remaining 70,522,000 acres are agricultural and forest lands. The plains are few, hill lands

predominating while mountains account for a high percentage of the area.

The only extensive Italian plain is that of the Valley of the Po bounded by theAlps, the Apennines, and the Adriatic Sea. Next, come the far smaller plains of Apulia and Lucania, and those of Tuscany, Latium and Campania bordering on the Tyrrhenean Sea. Sicily has narrow stretches of flat land along the coast, in Sardinia plain lands account for only a small percentage of the area. A few other plains are found in other regions.

The crops grown on the arable lands and those grouped under the heading " specialized tree, vine and bush crops " are specified below. We would here note that they occupy 52.7 per cent. of the total agricultural and forest area. This percentage is remarkable. If to this be added that under permanent meadows, the total stands at 56.6 per cent., a high percentage whose significance will be made clearer by the facts set forth below. The characteristic feature of *permanent meadows*, as distinct from arable land on which forage is grown, is that the forage is only used when mowed. It may be noted that the word " permanent " in " *permanent pastures* " and " *permanent meadow-pastures*," signifies that the lands are permanently (anyhow, for more than ten years) untilled. Sometimes permanent meadows represent such a high system of production that grazing would injure them. Nearly 27 per cent. of these lands are irrigated and they often enjoy abundant water supplies. Most of them are in North Italy.

Among the permanent meadows are the beautiful meadows of the Piedmontese, Lombard and Venetian plains, to which so much loving care is given. They are all used by specialized dairy herds. As a rule, the grass is cut four times from May to October; on the famous *marcite* lands from six to nine cuts are made.

The *marcite* lands are so arranged that a thin veil of water flows over them during the winter months whose relative warmth keeps the land from freezing, thus preserving the vegetation. The mode of fertilizing the *marcite* is also characteristic, based on the use of the so-called *terricciato* (two parts soil mixed with one of farmyard manure left to ferment with the addition of stable urine and turned over several times in the course of a year), chemical fertilizers, and in some instances sewage water.

The *permanent meadow-pastures* are those on which the grass is cut in the spring and on which live stock graze during the other months. When the grass is used only for grazing, the lands are described as *permanent pastures*. These two headings group lands of very different kinds, ranging from Alpine grass and grazing lands, often well-watered and so skillfully used that in many cases they not only graze the local cattle but also the big herds of milch cows and heifers coming in the summer months from the valley of the Po—down through successive grades to the extensively farmed lowlands of the *latifundia*.

The lines along which Italian agriculture is progressing are: (*a*) more intensive farming of arable lands; (*b*) the improvement of the permanent meadow-pastures and permanent pastures, or their conversion, when possible and advisable, into arable lands; (*c*) better cultivation of the specialized tree, bush and vine crops and the selection of the products; and (*d*) the reconditioning of mountain lands and their reafforestation. Action along these lines is described on p. 1048 under the headings *Integral Land Reclamation* and *Wheat Campaign*.

Arable Crops and Specialized Tree, Bush and Vine Crops. In view of the environmental and demographic conditions mentioned above, it is not surprising that Italian agriculture is characterized by the great variety of the crops grown. They range from flowers to rice, corn, wheat, sugar-beet, hemp, tobacco, the several market garden crops, to almonds, citrus and a great number of fruits, vines, olive-trees, oil seeds, aromatic and medicinal plants, forage crops, etc. The farming methods required differ for each crop and each represents a different form of economic organization. As space forbids a detailed account, the leading groups of arable crops are summarized in Table I. The data given are those of the 1929 Agricultural Survey, since which Italian agriculture has made further progress. More especially, the production data are insufficient, for although the areas change but little, production is affected from year to year by varying meteorological conditions. Moreover, the technical improvements introduced aim at increasing the yields. To remedy in part this defect, we have inserted in the Table a column giving the per acre yields obtained in 1937, the last year for which final data are available.

The importance of the leading tree, vine and bush crops can be judged from the following figures for yields obtained in 1937, in millions of lb.

Oranges 668, tangerines 112, lemons 624, cedrats 19, chinott bergamots 67, wine grapes 11,953, table grapes 241, raisin grapes 4 apples 747, pears 483, quinces 12, pomegrantes 9, cherries 162 peaches 575, apricots 61, plums 127, almonds 347, walnuts 125 hazel nuts 47, carobs 120, fresh figs 715, dried figs 189, prunes 0·4 chestnuts (1936) 754, etc.

The great variety of crops grown offers an insurance against weather vicissitudes, while, as is known, intensive and active farming help to reduce natural risks. In a country such as Italy the regulation of watercourses is of special importance in preventing loss due to the lack of such regulation. Water, when used for irrigation on lands enjoying abundant sunlight, gives surprising results, and the rapidly extending use of water power for generating electric power will be of the greatest importance not only for agriculture but for the whole life of the country. These are not only factors in the progress of Italian agriculture, but they are essential to its very life, which is built up of so many and so diverse elements.

Animal Husbandry. Present agricultural policies are calculated to ensure a considerable increase in the number of cattle, swine, and sheep. The number of goats is declining.

The improvement of mountain grazing lands, the spread of crop rotation, the plentiful use of stable manure to secure high yields per unit, irrigation works, and the erection of silos for storing forage, together with changes in diet and the disappearance of the dislike of the country folk for cow's milk, all favour the increase of cattle. The drought experienced in the first half of 1938, which reduced the forage crops, and a slight outbreak—fortunately soon checked—of foot-and-mouth disease, are temporary checks on the recovery of cattle breeding which had followed the removal of difficulties caused by former commercial treaties, but they have ceased.

The "maremmani" are a breed of cattle deserving of note for their special value as draught animals. These long-horned oxen are a "podolic" breed brought into Italy—it is thought—during the Barbarian invasions. The herds often move at a gallop like horses and their rapid movement and strength make them particularly well suited for field work.

Sheep are of special importance for their wool, milk (from which *pecorino* cheese is made) and meat. Forty-day-old lambs are a favourite meat in Rome. Sheep breeding has

experienced many difficulties, partly due to the reduced export trade in *pecorino* cheese, and the competition of foreign wool, but also to the need of revising methods to bring them into keeping with improved agricultural conditions. The need for this revision was more especially felt as regards the flocks which migrated in the summer months into the mountains, coming down in the winter into the warmer lowlands in accordance with practices dating back to Roman times, for as the lowlands are being gradually brought under the plough those permanent grazing areas, used only in the cold months and parched up in the summer, are gradually shrinking. The policy now is to keep in the lowlands small grazing areas for the sheep, which, during the months they spend in such lands are fed on forage grown in rotation with other crops. The price of wool, which must now be delivered to pools, has been fixed by the guild. In 1937, exports of *pecorino* cheese amounted to 20 million lb., valued at 87,118,000 lire.

Besides the goats kept on some farms, herds are also kept in some parts of the country as a business. They are a danger to agriculture and still more to forests; they are generally found on poor lands and hinder the work of improvement. Legislation has been framed to get rid of them.

Poultry farming is of considerable importance. Besides the valuable Leghorn and other choice breeds, Italian poultry-yards are stocked with strong, healthy birds noted for their fine eggs.

The production of silk cocoons in 1937 amounted to 70 million lb., obtained from 488,521 oz. of silk-worm eggs.

Size of Farms and Form of Farm Management. An agricultural census was taken in Italy in March, 1930, in connexion with the first world agricultural census organized by the International Institute of Agriculture. Among the data returned for the first time were those on the number and size of Italian farms, classified by area and form of farm management. Table II summarizes the data on the number of farms and Table III those on area.

To avoid erroneous conclusions, it should, however, be borne in mind that it is difficult to summarize the facts concerning Italian agriculture, a right understanding of which requires detailed analysis.

With highly intensive market-garden farming, raising, for instance, certain choice vegetable crops, the area can be

TABLE II.—NUMBER OF FARMS CLASSIFIED BY SIZE AND FORM OF FARM MANAGEMENT
(Agricultural Census 19.III.1930)

Size Groups ‡	Farms Run by Owners	Farms Leased by Owners	Farms Occupied on Share System *	Farms of Mixed Tenure †	Total	
					Absolute Data	Percentage
Hectares						
Up to 0·01	26,145	27,597	611	355	54,708	1·3
From 0·0101 to 0·10	174,612	61,246	5,039	4,318	245,215	5·9
,, 0·1001 ,, 0·50	450,128	93,136	33,769	32,826	609,859	14·5
,, 0·5001 ,, 1	386,924	84,823	46,153	63,399	581,299	13·9
,, 1·01 ,, 3	750,694	156,870	125,480	239,546	1,272,590	30·3
,, 3·01 ,, 5	289,436	46,974	76,158	120,259	532,827	12·7
,, 5·01 ,, 10	236,435	40,314	115,328	100,132	492,209	11·7
,, 10·01 ,, 100	151,548	50,351	126,960	57,636	386,495	9·2
,, 100·01 ,, 2,500	11,984	4,441	1,128	2,980	20,533	0·5
Over 2,500	506	18	—	7	531	0·0
Total {Absolute data	2,478,412	565,770	530,626	621,458	4,196,266	—
Total {Percentage	59·1	13·5	12·6	14·8	—	100·0

* Farms managed jointly by owner and farmer.

† Farms consisting of lands held under diverse forms of tenure (under two or all three forms mentioned separately in the 3 previous columns)

‡ 0·01 ha = 0·02 acres, 0·10 ha = 0·25 acres, 0·50 ha = 1·24 acres; 1 ha = 2·47 acres, 3 ha = 7 acres, 5 ha = 12 acres, 10 ha = 25 acres; 20 ha = 49 acres; 50 ha = 124 acres, 100 ha = 247 acres, 200 ha = 494 acres; 500 ha = 1,236 acres; 1,000 ha = 2,471 acres, 2,500 ha = 6,178 acres

TABLE III—FARM AREAS CLASSIFIED BY SIZE AND FORM OF MANAGEMENT
(Agricultural Census 19 III 1930)

Size Groups ‡	Farms Run by Owners	Farms Leased by Owners	Farms Occupied on Share System *	Farms of Mixed Tenure†	Total	
					Absolute Data	Percentage
Hectares	Acres (000's omitted)	Acres (000's omitted)	Acres (000's omitted)	Acres (000's omitted)	Acres (000's omitted)	
Up to 0·01	1	1	—	—	2	0·0
From 0 0101 to 0·10	25	7	1	1	34	0·1
,, 0·1001 ,, 0·50	332	70	28	27	457	0·7
,, 0·5001 ,, 1	730	160	90	122	1,102	1·7
,, 1·01 ,, 3	3,457	705	613	1,151	5,926	9·1
,, 3·01 ,, 5	2,799	451	757	1,163	5,170	8·0
,, 5·01 ,, 10	4,080	707	2,100	1,717	8,604	13·3
,, 10·01 ,, 20	3,352	931	3,142	1,312	8,737	13·5
,, 20·01 ,, 50	3,115	1,371	2,299	1,095	7,880	12·1
,, 50·01 ,, 100	1,964	1,009	770	660	4,403	6·8
,, 100·01 ,, 200	1,987	970	312	636	3,905	6·0
,, 200·01 ,, 500	2,958	1,006	116	679	4,759	7·3
,, 500·01 ,, 1,000	2,609	392	37	278	3,316	5·1
,, 1,000·01 ,, 2,500	3,603	276	7	169	4,055	6·3
Over 2,500	6,263	192	—	63	6,518	10·0
Total {Absolute data ..	37,275	8,248	10,272	9,073	64,868	—
Total {Percentage ..	57·5	12·7	15·8	14·0	—	100·0

*, †, ‡ See Table II.

measured (as that of hot-house crops) by the square yard. A few rods of fertile, irrigated land on the Riviera planted to flowers may represent a not unimportant farm unit. Owners of terraces planted with lemons and tangerines along the Amalfi coast reckon their holdings by the number of trees, a few dozen, occupying some hundreds of square metres, representing an economic unit of no negligible value.

Similar considerations apply to the big central block of farms ranging in size from 7 to 124 acres, which account for 46.9 per cent. of the total area, and over 80 per cent. of the lands farmed on the share system. In this group are found admirable types of farm management ranging from the irrigated farms of Lombardy to the share system farms of Tuscany, Umbria and the Marches, and the very different types of farms found in other parts of the country.

At the other end of the scale are the great estates, consisting mostly of woods and grazing lands, often owned by Communes and subject to common servitudes, or else lands extensively farmed under the *latifundia* system.

We also find, more especially in mountain districts, holdings so small that they cannot absorb in full the labour of the farm family and are inadequate to meet their needs; but the people, however, enjoy the right to use the grazing lands and woods belonging to the Commune.

If to the percentage (59.1) returned for farms run by owners be added the percentage (12.6) for those occupied on share system, the ratio of farms in which the landowner participates directly in the management rises to 71.7 per cent. of the total number; a similar calculation for area gives a percentage of 73.3.

Tables II and III show how close are the ties between the closely settled population and the land they cultivate under such a variety of forms.

Given the basic structure above described, present agricultural policies favour (*a*) the introduction in backward areas of intensive régimes of production, this being the purpose of integral land reclamation; (*b*) the introduction on the farms of methods based on recent scientific and technical progress —this being the purpose of the wheat campaign, and (*c*) the enhancement of the economic value of farm products, which is the purpose of the collective pools and of the guild price policies. These three lines of activity are dealt with in the following sections.

Integral Land Reclamation. Land reclamation in Italy dates back to antiquity. The legislation enacted in the early days of Italian unity was, however, chiefly inspired by the desire to drain marshy lands for health purposes, a step backwards when compared with previous measures enacted in some of the Italian States, for instance in the Kingdom of Naples.

Integral land reclamation is no longer understood as the execution of one or other piece of reclamation work, but as the reclamation of definite territorial units. Wherever reclamation is required, the whole territory involved in the undertaking is first defined, and the land-reclamation district thus delimited includes not only the area on which exist the conditions to be modified, but also the area responsible for causing those conditions. In Italy, lowlands are often flooded by water bringing with it soil and other matter from the surrounding mountains. In such instances the reclamation of the lowlands would be useless unless the conditions in the highlands were set right.

For each land-reclamation district a plan is made covering all the works needed to bring the land up to the agricultural, economic, social and political standards aimed at. Systematic attention to all the steps required to ensure the attainment of the purpose is what gives an *integral* or *complete* character to these reclamation works which cover a great variety of operations—the reconditioning of mountain lands, the regulation of watercourses, drainage, irrigation, aqueducts, ploughing waste or fallow lands, soil conditioning and improvement, experimental work, roads, buildings, the erection of villages, churches, schools and other social requirements, electric power and distributing systems, etc.

Some of these works are for the protection of agriculture threatened by natural causes; to this class belong those required to prevent swampy conditions from injuring farm lands as the result of a rise in the level of a river bed. Such works are described as " protective reclamation."

Much more frequently the purpose of the works known as " transformation reclamation " is to allow of the introduction of a new agricultural régime. To this class belong the great works carried out by the Fascist Government, chief among which is the foundation of the Province of Littoria, marking the end of the Pontine Marshes.

The cost of each reclamation is divided between the Govern-

ment, which finances the several works in a measure varying according to their nature, and the land-owners.

Space does not allow of a detailed account of the classification of land reclamation works, but they fall under the following two main groups:—

(*a*) Works of public interest, to the cost of which the Government may contribute as much as 60–100 per cent.

(*b*) Works relating to the separate estates—some obligatory, others optional—the cost of which is generally met to the extent of one-third by the Government.

For each land reclamation district, an association of the land-owners is formed to execute the works of public interest on behalf of and under the supervision of the Government and which undertakes specific responsibility for the execution of the works each land-owner is required to carry out on his own estates.

A special part is played in the execution of land reclamation work by the Ex-Service Men's Foundation (*Opera Nazionale Combattenti*) set up at the end of the Great War. This organization has the right to ask that lands within reclamation districts or susceptible of important land improvements, or required for purposes of land settlement, be made over to it.

The spinal column of integral reclamation is the Act of December 24, 1928, which provides a financial plan for carrying out in a period of 14 years works costing 7,000 million lire, of which 4,300 million is supplied by the Government and the remainder by the land-owners.

The Act was followed by a Decree of February 13, 1933, regulating details. A Decree of January 13, 1938, assigned a further sum of 3,000 million lire for the execution of works to be carried out in those reclamation districts which best lend themselves to land settlement and other improvements.

The area comprised within land-reclamation districts covers a total of 22 million acres, on 9,400,000 of which, however, work has not yet been started. Of the remaining 12,600,000 acres, 6,200,000 have already been reclaimed or the work is nearing completion. The new credit of 3,000 million lire above referred to will ensure the complete reclamation or technical reconditioning of nearly 15 million acres.

The reclamation districts are scattered all over the country. Space does not allow us to refer to the leading characteristics of the chief works. Those of the Littoria district can be summarized as follows:

The Pontine Marshes, refractory down the centuries to all

efforts to drain and reclaim them, were a malaria-infested zone covering 190,000 acres stretching from the Lepini and Ausonian foot-hills to the sea, across which ran the Appian Way. The rainfall and the streams rushing down from the mountains formed swamps and ponds, in some parts owing to the low level of the lands, in others because their outflow was hindered by cliffs and by the wild disorder of the whole area.

The reclamation plan classified the waters into *high waters* flowing down from the mountains, for which canals are built leading them to the sea; *middle waters* for which canals are built and which flow by gravity to the sea; and *low waters*, which are collected and raised by hydro-electric pumps.

Government works for drainage, road building and the conditioning of the lakes, have been carried out by the Pontine and Littoria Land Reclamation Consortia. The Ex-Service Men's Foundation has brought the land under cultivation and divided it into farm lots, and has built the villages and towns; the *Università Agrarie* (agricultural communities) and the owners of the remaining lands have carried out the part assigned them in the work of forming farm units.

The territory above referred to now forms the central part of the Province of Littoria, which has the town of Littoria as its centre, and to which the two new communes of Sabaudia and Pontinia belong. The other new commune, Aprilia, is in the Roman Campagna beyond the boundaries of the Pontine Ager, as is Pomezia, of which Mussolini laid the first stone on April 22, 1938, and which will be completed in October, 1939.

Taking the reclaimed area of the Aprilia district jointly with that of the Pontine Ager, the total reclaimed farming area stands at 148,000 acres, of which 120,000 have been reconditioned by the *Opera Nazionale Combattenti* and 28,000 by the Agrarian Communities and private land-owners. On this territory, 3,147 farmhouses have been built, corresponding to a like number of farms carrying 24,000 head of cattle. Instead of a few scattered herdsmen, the territory now has a population of some 60,000 inhabitants and has been freed from malaria.

The Wheat Campaign. Twelve million of Italy's 70,500,000 acres of productive land (of which 32 million are arable) are under wheat. It is the leading Italian crop around which all Italian agriculture and rural life revolves, and is the basic food

of the people. The Wheat Campaign means more than a mere effort to raise wheat yields. It has afforded the means for extending the latest improvements in agricultural practices and for increasing the available supplies of farm products.

Another fundamental consideration is that the annual wheat imports averaged over the five-year period 1921-25 amounted to 5,510 million lb., costing some 3,500 million lire, and accounting for 50 per cent. of the trade deficit of those years, a deficit which used to be largely settled with emigrant remittances, but which must now be reduced.

The Wheat Campaign opened in July, 1925, when the Permanent Wheat Committee presided over by Mussolini was set up. Its task was to propose to the Government means for increasing wheat production, and the proposals it made were enacted in the same month.

The object was to raise the unit yield rather than to enlarge wheat acreage, and the problems the Committee had to study were: (1) seed selection, (2) fertilizers and technical improvements in general, and (3) prices.

A detailed account of the work done cannot be given here, but results secured are reflected in the following Table:—

TABLE NO IV.—WHEAT PRODUCTION

Period	Area	Production	Yield Per Acre
Annual average	(acres)	(million lb.)	(lb.)
1909–1914*	11,762,000	10,863	928
1920–1925	11,513,000	11,305	981
1926–1931 . ..	12,081,000	13,631	1,124
1932–1937	12,479,000	16,122	1,294
Year			
1938	12,410,000	17,817	1,436

* Pre-war territory.

Not only has the Wheat Campaign considered all aspects of cericulture, from the breeding and registration of selected seed to the several operations involved in wheat growing, the methods of threshing, and the delivery to collective pools, but its activities have been gradually extended to cover other technical problems affecting the farm. Thus, the National Wheat Competition, whose annual programme lays down the policies guiding the further action of the Campaign, has developed into the National Wheat and Farm Competition. Three million

lire are offered in prizes for the 1938-39 crop-year by this competition under the five following heads: (1) per acre increase of wheat yield, (2) rational arrangement of farm lands, (3) increase of the yield of maize, beans and potatoes, (4) improvements in the cultivation of forage crops and animal husbandry, and (5) increase in the production of choice market-garden crops.

Collective Pools. The term "guild price" is used to designate a price fixed by the guild on which sit representatives of the Government, the Fascist Party and the several branches of production concerned. To encourage production by securing the best prices compatible with the just claims of consumers, collective pools have been organized. These pay farmers a fixed price valid for the whole year, with fixed percentage variations for quality differences from the standard agreed on. Agreements between the marketing agencies and the processing industries have made the prices paid to farmers independent of world market prices.

The regulations governing the pools are gradually tending towards uniformity, but they still vary with the products handled, the character of the several markets, and the special problems affecting each product.

Delivery to collective pools is now prescribed for wheat, rice, wool, hemp, silk cocoons, bergamots, saffron and manna.

* * *

EDITOR'S NOTE. In the above article, demands on space have prevented more than a brief reference to two of the more spectacular developments of recent years, namely, the campaign for an increased production of wheat, and the schemes of land reclamation. With regard to the latter, those readers who desire to follow up this matter may be referred to Signor Longobardi's *Land Reclamation in Italy*,* or to the brief descriptive account recently published by Mr. Christopher Turnor—*Land Reclamation and Drainage in Italy*.†

By way of contrast to Signor Longobardi's article, reference might also be made to a book recently pulished by Mr. Carl T. Schmitt of the Department of Economics, Columbia University, under the title, *The Plough and the Sword*—

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* *Land Reclamation in Italy*. By C. Longobardi. Pp. 243. Illus. London: P. S. King. 1936 Price 12*s*. 6*d*.

† *Land Reclamation and Drainage in Italy*. By Christopher Turnor. Pp. 24. Illus. London: P. S. King. 1938. Price 1*s*. 6*d*.

*Labour, Land and Property in Fascist Italy.** As its title implies, in this volume Mr. Schmitt reviews the agricultural activities of Fascist Italy. His conclusions, however, are critical of the Fascist régime. In regard to the campaign for self-sufficiency in wheat supply, Mr. Schmitt agrees that the plan is achieving its object to a substantial degree, but he contends that the increased wheat production has been purchased at the cost of seriously unbalancing Italian agriculture, and of imposing a heavy burden on workers and consumers. Again, in regard to land reclamation, he argues that the benefits are not accruing to the general welfare. The book presents a very interesting and readable study.

* *The Plough and the Sword.* By Carl T. Schmitt. Pp. vii + 197 New York: Columbia University Press. 1938. Price 12*s.* 6*d.*

JANUARY ON THE FARM

R. W. Wheldon,
King's College, Newcastle-upon-Tyne

The year starts with work well forward on most farms, especially in the east. In the north and west, where the rainfall has been high, late harvesting has in some places hindered autumn cultivation. A large area of wheat has already been sown and, no doubt, the good returns obtained in 1938, as compared with other cereals, due to the deficiency payment, will encourage the sowing of a considerable spring acreage.

In spring it is usually desirable to sow a heavier seeding per acre than in the autumn, and great care should be taken to obtain a satisfactory seedbed. Good plant establishment is specially important with spring-sown wheat, as later in the season the plant tends to send up flowering stems rather than tillers, and, in any event, if the energy of the plant is occupied with producing tillers in spring, maturity may be delayed and harvest risks thereby increased. Care should be taken to obtain the right variety for spring sowing. At Cockle Park for the past two seasons Extra Kolben II has given the heaviest yield per acre, although it never looked as well as some other varieties during the growing season. On land which is not in good heart the application of a fertilizer containing a fair proportion of nitrogen is desirable, as this helps to give young plants a good start.

Cattle. The mild weather during the last three months encouraged the growth of grass, and on many farms, stock have been able to get a good proportion of the necessary roughage out of doors. Outlying cattle which have not been receiving hard keep, such as hay, tend to suffer more during very severe spells and it is desirable that a proportion of this type of keep should be supplied to enable the animal to withstand such conditions. For milking cows which have been out late in the season and have grown a large amount of hair, cool sheds are an advantage. The appearance of animals with heavy coats is frequently deceptive as they do not carry as much flesh as might appear from general observation, and extra food should be given to prevent loss of condition.

Sheep. On many lowland farms in the south of England the present month sees lambing in full swing. Good weather at such a time is a great help as both the ewes and lambs do better when running out. Shepherds are concerned to keep a good supply of milk on the ewes and are usually insistent on obtaining the best of food. Just as heavy milking dairy cows do best when they are not allowed to go long periods without food, the milking ewe should be fed as early as possible in the morning and as late as convenient in the evening. Ewes do not feed so readily in the dark, and the best use should be made of daylight. A well-balanced ration containing enough protein and starch equivalent for maintenance and milk production should be fed, and it is of equal importance that it should suit the digestive system of the ewe. It is important that early lambs should be encouraged as early as possible to eat suitable trough feed, such as linseed cake, flaked maize, bran, crushed oats and locust beans. Later-born lambs usually go to the pasture with the ewes and take a certain amount of the young grass.

Large numbers of grass sheep, such as the half-bred (Border Leicester X Cheviot) are now used for breeding in the south and midlands, having replaced the down breeds when areas of land were sown down to pasture. When breeding-sheep of this type are folded on roots, as is sometimes done, it is an advantage if they can be given a run on grass at night or during the day. Some exercise for these open range sheep may do much to reduce lambing troubles.

On hill farms, the shepherds usually keep a close watch for any ewes which are not thriving, and these are brought in to lower ground. In spite of the wide range covered by hill flocks a careful eye is kept on the sheep, and individuals are well known to the shepherd. This is particularly so in Scotland and the north of England. Where the system of stinting on common hill grazing is followed, such close shepherding cannot be practised so well. This applies to some of the hill land on both sides of the Pennines in Durham, Westmorland, Yorkshire and Lancashire.

Pigs. Lower feed costs have in some ways helped the pork and bacon producer, but although the cost of food is of prime importance, other factors need consideration, particularly the organization of labour to reduce costs, and the selection of the right kind of animal. There has been much discussion

during recent years as to which breed is most satisfactory for bacon production. The curer is mainly concerned with the production of first quality bacon; the producer is concerned also with the ability of the animal to utilize food efficiently, with prolificacy, milking qualities of the sow and with temper and mothering properties generally. The popularity of the Large White is probably due to the fact that it has all these qualities in fair measure and is not seriously lacking in any of them. Certain other breeds have prolificacy, mothering properties and make excellent gains for food consumed, but suffer from a colour handicap. For this reason the sows are largely used for crossing purposes, to give the advantage of their good qualities when mated with white sires. While there are undoubted differences in breed characteristics, it should always be remembered that strain within the breed often accounts for greater economic differences than breed. While animals of suitable conformation must be secured in the purchase of breeding stock, it sometimes happens that the other qualities referred to get little attention. One pig per litter more on the average and 10 per cent. greater efficiency in food conversion would help much to reduce costs. Such differences between strains are by no means uncommon, even when the grading *quality remains the same.*

Rotational Farming. The introduction of rotational cropping marked a great step forward in connexion with our farming. The old Norfolk four course was the basis of rotations practised in most parts of the country, although frequently modified to suit local conditions. Rotational or systematized farming flourished best under settled conditions of prices and costs, as a long term policy could then be followed. Needless to say, farming has not known these conditions during recent years. Primary producers need a reasonably long outlook as they cannot commit their resources to a particular system unless there is some prospect of return. When such conditions do not obtain there is a great tendency to resort to measures of expediency and depart from system. It is important to bear in mind that some sound system of cropping is necessary for the successful production of crops over a number of years. The troubles arising from the too frequent repetition of crops are well known to farmers. If great care is not taken much disorganization or unsatisfactory results may be obtained. These harmful results may

not be seen for a year or two, but once troubles have appeared they are not readily eliminated. Any serious departure from the system in use should be carefully considered and plans laid for a few years. Speculation as to market prices involves considerable risk.

Labour charges on arable farms form a large item of expenditure, and in many instances staffs have been considerably reduced; on some farms machinery has been brought in to replace manual and horse labour. Whatever change is made, it is most important that the production of a satisfactory crop is safeguarded. The cost per acre may be reduced and the cost per quarter of grain increased. It is the actual cost of the product that really matters. In this country the season during which a crop can be sown so as to give a satisfactory return is limited, and shortage of labour may result in the crop being sown late, with corresponding loss. It may not be too much to say that failure to plant or sow the crop at the right season under good conditions of soil is responsible for as great an amount of loss as any other single factor. The depressed state of the industry has resulted in the loss of many skilled men from the land and prevented the recruitment of suitable young men for training. Efforts to assist with training of farm workers are now being made, but whatever may be done in this respect the real training ground for practical work is on the farm. This being so, much of the responsibility for training rests with the employer. During times of depression this responsibility tends to receive less attention. An additional factor affecting training of young workers is that the farmer to-day requires to devote more time to the management and clerical side of his business. Rapidly changing market conditions and the large amount of clerical work involved on a mixed farm tend to keep the farmer away from the workers more than formerly. This is a great loss as no one as a rule is better able to help than the employer himself.

The introduction of machinery needs careful planning. On many farms, the introduction of machines has not been followed by a corresponding reduction in horses and other labour, and thus the full advantage of the change has not been realized. Efficient labour in handling machines is important, not only from the point of view of keeping the machine in working order, but in turning out work of the right quality. Undoubtedly, mechanization has been successful on many

farms, but on these it is invariably found that the farmer is able to stimulate interest and enthusiasm among his workers. For success in mechanization, the farmer's responsibility goes beyond purchasing the right type of machine and equipment, important as these may be; it involves seeing the work through under the best conditions obtainable.

COUNCIL OF AGRICULTURE FOR ENGLAND

Addressing the Council of Agriculture at its 51st Meeting, held on December 8, 1938, under the Chairmanship of Lord Cranworth, the Minister of Agriculture, the Rt. Hon. W. S. Morrison, M.C., K.C., M.P., briefly reviewed the position of agriculture. He pointed out that without the Wheat Act, the Livestock Act and other measures, the position of agriculture to-day would be far worse than it is. He felt that in recent years a change in public opinion in regard to agriculture could be discerned which promised well for the future development of agricultural policy. Discussing the position of agriculture in relation to National Defence, the Minister said that in the event of war our agriculture would be called upon to make an increased contribution to the nation's food supply and the necessary measures would be taken under war-time legislation. He had, however, never taken the view that we ought in peace-time to put agriculture on a full war-time basis. "To do so, would be to cash our cheque before we wanted the money, and when we did want it, we should not have it." He considered that we ought in peace time to pursue an agricultural policy which not only had as its object the improvement of the prosperity of those engaged in the industry, but which also endeavoured to improve the fertility of the soil and the health of the stock so as to provide for an emergency a store of fertility which could then be cashed in to the advantage of the nation as a whole.

Continuing, the Minister referred to the satisfactory progress made under the different schemes, e.g., land fertility, land drainage and the attested herd schemes. There had been no slackening in the demand for lime and basic slag; the number of contributions now exceeded 280,000, representing in cash nearly £1,200,000 for lime and over £300,000 for slag. Land Drainage Schemes estimated to cost £250,000 had already been approved for grant under the Agriculture Act, 1937, as compared with a total of rather less than £200,000 in the first season. On the subject of attested herds the Minister said that hopes had been raised that bovine tuberculosis might be entirely eliminated from the herds of this country within a few years. While good progress is being made, he had always made it clear that the process must inevitably extend over a long period and he did not expect results of a spectacular character within a short period of time. After referring to the recent measures taken to improve the position of the farm worker, the Minister briefly

discussed the progress made under the Livestock Industry Act, and referred to the general welcome which had been given the dairying industry."

Wheat and poultry would be the subjects of two other Bills withdrawal of the Milk Industry Bill. This was inevitable in face of the widespread opposition which had centred around the proposals for making an experimental approach to the great question of distribution. It was frequently said in many quarters that one of the troubles from which agriculture suffered is the wide spread that exists between what the producer gets and what the consumer ultimately pays, on which problem Commissions of various sorts have reported from time to time. It was not easy to ascertain the complete truth of statements of that general character without experiment, and these experimental proposals in the Bill were designed to see where the truth lay in this matter. The Minister added: " From a combination of convergent hostilities it has not been possible to proceed with the Bill, but we shall have to think again and see what we can do to improve the condition of the dairying industry.

" Wheat and poultry would be the subjects of two other Bills to be introduced in the course of this Session. The first one would provide for an amendment of the Wheat Act, including provision for a review of the standard price in 1939 and every three years afterwards; the second would provide for setting up a system to deal with the problems of the poultry industry and it would follow the general lines of the recommendations of the Poultry Technical Committee. These two Bills were in active preparation and would be introduced into Parliament at the earliest possible moment.

Continuing, the Minister said that it was a feature familiar to everyone who occupied his office that conditions in agriculture sometimes changed so rapidly as to bring forward very suddenly and into prominence features which a year before were not the cause of so much concern, and there was no doubt in his mind that in the present circumstances of agriculture the most serious and urgent problem with which we were faced was the position of the light-land farmer in districts like parts of Norfolk and the Wolds of Yorkshire and Lincolnshire. They could almost be described as ' depressed areas ' in agriculture. By a most unfortunate coincidence, the two chief commodities on which farmers in those districts rely, namely, barley and sheep, had

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CORRECTION

Page 1060. The first three paragraphs should read as follows:

Council of Agriculture

discussed the progress made under the Livestock Industry Act, and referred to the general welcome which had been given to the Bacon Industry Act.

There was, however, one setback to record, in the recent withdrawal of the Milk Industry Bill. This was inevitable in face of the widespread opposition which had centred around the proposals for making an experimental approach to the great question of distribution. It was frequently said in many quarters that one of the troubles from which agriculture suffered is the wide spread that exists between what the producer gets and what the consumer ultimately pays, on which problem Commissions of various sorts have reported from time to time. It was not easy to ascertain the complete truth of statements of that general character without experiment, and these experimental proposals in the Bill were designed to see where the truth lay in this matter. The Minister added: "From a combination of convergent hostilities it has not been possible to proceed with the Bill, but we shall have to think again and see what we can do to improve the condition of the dairying industry."

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both fallen in price. If the price position of one of those two staple commodities was good, it could carry the other, but when both of them were down, as at present, a very deplorable situation was created. Prices of sheep had lately remained steady at a season when they might normally be expected to fall, and they were now showing some signs of recovery. He was not contented yet with the mutton and lamb import position; it was, however, a matter that required a good deal of negotiation and consequently could not be done as quickly as one might imagine.*

As regards barley, the plight in which many growers found themselves this year was due, not to a bad season, but to the crop being exceptionally large and of very fine quality. Those who were fortunate enough to be able to put a good crop of malting barley on the market early in the season got a price for it which, though lower than the corresponding price last year, was not unremunerative. On the other hand, those who were unable to market their crop before the excess of supply over demand had made itself felt, had to accept a very low price indeed and in some cases could not sell at all. The Minister said that his colleagues and he were very sensible of the gravity of the position, and though he could not make any announcement at the moment, he could assure the Council he was giving earnest consideration and sympathy to the problem and to the possibility of taking measures to assist in the immediate difficulties.* At the same time, he was looking for methods of preventing a recurrence of a similar situation in the future. He concluded: "It is my earnest desire to try to do something for the especial benefit of the light-land farmer, who is a very valuable member of the agricultural community and whose prosperity is essential to a well-planned scheme of British agriculture."

In moving a vote of thanks to the Minister for his address, Prof. A. W. Ashby concluded:—

"This Council is free of parties, it is even free of unions; it is a body of men of experience, of knowledge, and I hope of some power of critical analysis and some power of providing long views for the industry. The industry should stand behind the Minister every day—criticizing him where it is necessary, but doing it constructively and thinking before it shouts."

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* See later statements by the Minister on pp. 977 and 978.

The following resolutions were considered by the Council:—

Application of Electricity to Agriculture. The Standing Committee's Report (see Appendix I) was adopted. *Alderman W. B. Pinching* (Middx) moved: "That the Council of Agriculture for England is of opinion that a cheap and abundant supply of electricity is an urgent need for the welfare of agriculture" was duly seconded and passed at the same time as the Report was adopted.

Quality of Store Cattle. The Council adopted the Standing Committee's Report (see Appendix II).

Drift of Workers from the Land. *Mr. Arthur Symonds* (West Suffolk) moved: "That the attention of the Minister of Agriculture be called to the continued drift of workers from the land which is causing less home production and home wealth and more derelict land and rough grazings; and to the fact that this matter is causing anxiety to Local Authorities in agricultural counties—in the provision of educational, social, and other services—as to the results that may follow if the drift is not arrested." The motion was seconded and adopted.

Guaranteed Minimum Prices. *Alderman Edwin Peat* (Derby) moved a resolution on this subject, which, on amendment, was passed as follows: "That the Council of Agriculture for England urges upon the Government the desirability of introducing immediately a definite policy for agriculture in order to enable the industry to take its rightful place in the national economy. For this purpose and for the encouragement of home production, it suggests that minimum prices for the main crops and for fat stock should be guaranteed. . . . It urges the Government, in the case of each such commodity, to work out the appropriate machinery for operating the guarantee, and to prescribe such prices as will secure the efficient producer a reasonable remuneration taking into account the cost of production."

Survey and Investigation of Agricultural Situation. *Mr. Christopher Turnor* moved: "That the Council of Agriculture for England urges the Government to carry out an investigation and survey of the agricultural situation without delay, in view of the fact that, without such survey and investigation, it is not possible to define objectives or to formulate a long-term agricultural policy to attain them." The motion was carried.

Sheep and Barley. *Mr. Christopher Turnor* moved: "That the Council of Agriculture recommends that the Government be requested to take immediate steps to relieve the disastrous position in which the sheep and barley farmer is placed, owing to the low prices of sheep and barley." The motion was carried.

Land Drainage. *Alderman T. P. Gilbert* (Kesteven) moved: "That the Council of Agriculture for England recommends that grants to Internal Drainage Boards under Part III of the Agriculture Act, 1937, which have hitherto been restricted to work done during the winter months, be made available in future for work carried out in any part of the year." The motion was carried.

Major S. V. Hotchkin, M.C. (Lindsey) moved a resolution, which, on amendment, was passed as follows. "That in view of the recent decision of the Ministry of Agriculture and Fisheries to approve suitable schemes submitted by the tenants of County Council Small Holdings for the purpose of grants for land drainage under Part III of the Agriculture Act, 1937, the Council of Agriculture for England requests the Ministry to pay grants on schemes carried out by such tenants since the coming into operation of the Act which would, apart from the earlier decision of the Ministry not to allow grants for such schemes, have been available for grant purposes." The motion was carried.

Import Duty on Tomatoes. *Mr. Bernard Rochford* moved: "That the Council of Agriculture for England suggests to the Government that the import duty on tomatoes should in future years be at a uniform rate from the middle of May to the middle of October and not as at present at a differential rate from May to August and from September to the end of October." The notion was duly seconded, but, after discussion, was withdrawn by the mover.

Land Settlement Association. *Mr. Bernard Rochford* moved: "That the Council of Agriculture for England considers that any serious extension of the activities of the Land Settlement Association and the Welsh Land Settlement Society is prejudicial to the established system of production by private enterprise, and is definitely uneconomic." The motion was duly seconded, but was, after discussion, adjourned.

APPENDIXES—REPORTS OF THE STANDING COMMITTEE

I. The Application of Electricity to Agriculture.

1. The Standing Committee has had under consideration the question of the application of electricity to Agriculture. The subject is one of ever-increasing importance to the industry, though the position exists that, in some districts, the cost of bringing current to farms and villages is prohibitively high. This appears to be largely due to the unavoidable length of service cables, but the position might be improved by a different organisation of distribution. The provision of electricity as a national service available alike to all consumers on payment of reasonable costs should be the rule all over the country; and it would be an advantage if means could be found of so distributing costs of laying service lines that no village, hamlet or farm should be too remote or difficult of access to be supplied with electricity at an initial cost—or an annual rate based largely on initial cost—which would be agreed by all concerned as reasonable. It is not, however, the Standing Committee's intention in this preliminary Report to discuss these wider issues at length. It is rather the aim to explore the position as it exists at present leaving detailed recommendations to follow more complete enquiry, though it would hope that so serious a shortcoming as that referred to above would be remedied at an early date, and quite apart from any other of the recommendations of the Standing Committee on this subject.

2. At present, it is generally recognized that the use of electric current not only for lighting and heating in farmhouses and villages but for power in the performance of several of the barn and farmyard operations on arable and grazing farms, also for up-to-date machinery in dairy holdings, for poultry farms, and in horticulture, is more efficient and convenient than any other usually available power. If electricity can be supplied at the same total cost, including capital charges, service for service, as any other available means, the industry will be anxious to obtain supplies because of the convenience in the use of current. With lower cost, the prospect of a rapid extension of current throughout country districts is assured. Before a satisfactory position in this respect is reached, however, much propaganda amongst the rural community is necessary as regards the details and possibilities of the supply, as well as in the cheapening of the cost so that farmers and the rural community generally may be in a position to guarantee a "load" sufficient to justify the Supply authorities in charging rates for current—apart from the question of initial supply—which the consumer will approve and find favourable. The case seems to us to be mainly one for the two parties to get together, and see how

far each can go in meeting the other's legitimate and reasonable requirements.

3. These broad facts are probably already known and recognized by the more advanced agriculturists, for the application of electricity to Agriculture is no new thing. There are, however, reckoned to be upwards of 150,000 of the larger farms in England and Wales still unsupplied with light or power, as well as a number of small villages, so that the rural business which awaits development by enterprising Supply authorities must be very substantial.

4. We understand that as a general rule the Supply authorities are prepared to deal with individual farms or groups of farms which require the contruction of a special line for their supply on the basis of an initial cash contribution and an annual guaranteed revenue. There are no doubt differences in the ordinary requirements of different Supply authorities, and there may be a case for endeavouring to bring authorities into line in this respect in the interests of a rapid distribution of current throughout the countryside. Different circumstances may require different treatment within certain defined limits, but it would certainly assist if a statement of minimum requirements and customary variations could be issued in plain terms for the assistance of the rural dweller in making his decision.

5. To understand the position more clearly, it may be useful to review a little of the history of the movement to supply electricity in the more immediate past. Under the various post-war Electricity Supply Acts, the problems of generation of current and organization of main transmission have been dealt with, and, to-day, generation is carried out more efficiently than formerly was the case, and the Grid System has made available to the large majority of Supply authorities electricity in bulk at the lowest cost efficient for their present and future requirements. It should be mentioned here that the main Grid System cannot be tapped for casual supply to farms, because the Grid is the means of carrying electric current at very high voltages. Notwithstanding improvement in generation and main transmission, however, it had to be stated in the McGowan Report on Electricity Distribution, dated May 8, 1936, that there were still no less than 627 Supply authorities registered as such at March 31, 1934, the latest date presumably for which figures were then available It was recognized that because of the differing powers and duties of Supply authorities considerable anomalies necessarily occurred which in practice, were found to hold up development. The multiplicity of undertakings involved a multiplicity of boundaries. Different tariffs, different systems and different kinds of facilities were being offered side by side according to whether a district fell in the area of one undertaking, or in that of another; sometimes it was a matter of difference on the two sides of a street. Something clearly had to be done to remove these obstacles to development, and the McGowan Committee recommended that powers should be taken, under the general oversight of the Ministry of Transport and the Electricity Commission, to simplify matters on lines which were indicated in the Report. The necessary legislation is under consideration.

6. As regards rural supplies of electricity, the McGowan Report, 1936, stated that :—

> "While rights to supply electricity now exist in respect of the country, the fact that until recent years Orders were, with few exceptions, only taken out for the more densely populated and remunerative areas has necessarily meant that rural areas were left to be dealt with separately and at a later stage. For this reason, development in the rural areas on an economic basis and at attractive tariffs has been rendered much more difficult."

"Many of the complaints which have been made as to the lack of development in rural areas do not appear to take into account the difficulties with which the Supply authorities have to contend."

7. Apart from the Supply authorities themselves, the chief bodies at present working in the field of electricity supply are, the Ministry of Transport, the Electricity Commission, the Central Electricity Board, the Department of Scientific and Industrial Research, the British Electrical Development Association, and the British Electrical and Allied Industries Research Association, of 15, Savoy Street, W.C.2. Of these, the last-named requires special mention in this Report, as one of its present activities is the study of problems associated with rural electrification *in the interests of users*. One of its Committees proposes to consider from the technical point of view all possible means of reducing the cost of giving service to isolated farms; and the possibility of raising the amount of electrical "loads" on farms and in country districts in the interests of consumers. These enquiries are of real importance to the industry and if carried far enough and pursued with vigour and determination, are likely to lead to very useful results. The Association has the support of all sections of the electrical industry as well as the Departments named above. Inquiries by farmers and others in connexion with any difficulty which they may experience in obtaining a supply of electricity, including representations as to the terms and conditions for connecting their premises to the Supply authority's system and the tariff for the electricity itself, should be sent to the Electricity Commissioners (Savoy Court, Strand, W.C.2), who are always prepared in appropriate cases to assist prospective consumers in their negotiations with the Supply authority concerned.

8. A different kind of assistance has been rendered in some counties by the county Rural Community Councils. These, in certain parts of the country, have assisted farmers by giving them information as to available supplies and probable costs, by summing up their requirements, and representing them to the local Supply authorities. Such action has been attended with excellent results in the counties of Derby and Nottingham, so much so, that these counties are in considerable advance of most other rural areas in England in matters of electricity supply. The Standing Committee understands that Rural Community Councils in other parts of the country are prepared, as independent voluntary bodies having no financial or other interest in the matter, to carry out similar useful intermediary offices.

9. The Standing Committee does not propose at this stage to do more than present these few observations and suggestions for the consideration of the Council and of the agricultural community. It will, however, be prepared, at a later date, to continue its enquiries, and to report to the Council on the other aspects such as the circumstances and progress made in the provision of lighting and power in individual sections of the industry, *e.g.*, dairying, horticulture, poultry keeping, and even in large scale arable farming.

November 22, 1938.

II. The Quality of Store Cattle for Beef Production.

1. The Standing Committee has reported to the Council on several occasions in the past on the cattle and beef situation. Recently, it has felt some concern at current reports that the quality of much of the young home-bred store stock now coming forward as the raw material for beef production is not so high as formerly, or as it might reasonably be expected to be having regard to the better prospects in the home beef markets

to-day. The *numbers* of store stock coming forward are increasing, but not, on the whole, the *quality*.

2. As to numbers of stores coming forward, the figures for "Other cattle—under one year" in June 4 returns of each of the last three years show that striking changes are taking place. In 1936, the United Kingdom figures (including Northern Ireland) were 39,000 more than in 1935; in 1937, 32,000 more than in 1936; and in 1938, 103,000 more than in 1937. The position in the Irish Free State, from which a certain number of store cattle are supplied to this country, also shows a strong upward movement in the same direction during the last year or two.

3. As regards quality, there will no doubt always be a fair supply of high-quality beef cattle in this country because of the position which it holds in the world markets as the home and manufactory of the beef breeds; but, as regards the general run of store stock, the quality depends on the changing circumstances of the industry from year to year and on the attention which far-sighted breeders and feeders give to it. The big change over to milk production which took place some few years ago and the shattering slump in prices for beef cattle, which reached its lowest point in 1935, caused farmers in general to pay less attention to the use of good quality beef bulls. The Government, however, did not relax its efforts during this time to assist quality production by means of the Livestock Improvement Scheme under which grants were given for Premium Bulls, and, later, by the Licensing of Bulls legislation which aimed first at the elimination of the scrub bull from country districts, and second at the gradual improvement of the standard of bulls kept for service.

4. In the review of Livestock Improvement in 1937-38 in the JOURNAL of the Ministry of Agriculture for November, 1938, the Ministry comments upon the progress made under both heads. A note of the outstanding points may be useful to the Council. They are that the revised rates of subsidy for quality cattle have undoubtedly led to an improvement in the trade for both fat and store stock; that the tendency in recent years to concentrate on milk production had led to indiscriminate breeding, and cattle in many districts, particularly after the first cross, have been found to be lacking both in quality and breed characteristics; prudent farmers are now paying more attention to the dual-purpose qualities of their cattle, and bulls with better conformation and constitution are in greater demand for the production of calves fit for rearing. During the year 1937–38, the Ministry increased the amount of the initial grant for Premium Bulls and also the numbers of premiums available, so that additional and better bulls of beef and dual-purpose types were placed out with suitable custodians. An important change, and certainly an improvement from the custodian's point of view, was that made in the basis of payment. Instead of grants being paid, as in earlier years, on the basis of one-quarter of the value of the bull each year of service (subject to a maximum of £20 per annum), a grant of one-half of the value (subject to a maximum of £40) is now paid at once on the location of a new bull. This initial grant, however, covers a period of two years, so that double the old grant, equal to one-half the value of the animal, becomes available immediately to meet the cost of the bull when purchased. A further grant of one-twelfth of the value (maximum £7) is payable at the end of the two years, and, for bulls which remain on location for more than two years, additional grants are paid on the basis of one-quarter of the value (maximum £20) for each further year. A record number of bulls were subsidized in the year 1937–38, viz. 1,547—exactly 100 more than in 1936–37. The standard of bulls purchased under the scheme was also greatly improved. The average price of bulls

purchased in the early part of the year, before the new regulations came into force, was just under £43 10*s*. In the latter part of the year, it was £59, the over-all average for the year being raised to £49 9*s*. or £7 7*s*. 6*d*. above the average price of the previous year (1936–37). Over 57 per cent. of the total number of bulls subsidized were shorthorns, and of the 1,547 bulls placed on location 1,119 were of beef or dual-purpose type.

5. The report of the Ministry outlined above shows the strength of the movement towards better quality beef production in districts in which Premium Bulls under the Scheme are relied upon. In our view, the Ministry's present hold on this situation should not in any way be relaxed for some years to come; rather should it if possible be strengthened so that in no district in which large numbers of young stock are bred for beef production should there be wanting the services of beef or dual-purpose bulls of a quality up to "premium" standard.

6. The movement is assisted also by the Licensing of Bulls regulations, though here the Standing Committee is not so satisfied with the showing.

It will be remembered that under the Improvement of Livestock (Licensing of Bulls) Act, 1931, all bulls are required to be licensed for use. In the twelve months ended March 31, 1938, 36,685 were licensed and 5,942 rejected. The percentage of bulls rejected increased from 7 per cent. in 1935 to 14 per cent. in 1937–38, whilst the percentage of appeals against rejection mounted from 3·6 per cent. to 10 per cent. over the same period. Of these appeals, taking the last two years, 299 out of 540 were decided in favour of the appellant in 1936–37, whilst in 1937–38 346 were decided in favour of the appellant out of 657 appeals. It would appear therefore that while the standard of bulls licensed has improved in recent years, the number of appeals given in favour of the appellant has also increased. In the interests of the improvement of livestock the higher standard for Licenses should be maintained with the help of a tightening-up of the standards followed by the referees.

7. At the same time, it is noted that the number of crossbred bulls submitted for licensing showed a considerable decline and that over 91 per cent. of those submitted were rejected as unsuitable for breeding. There are occasional instances of deliberate evasion of the requirements of the Act, and successful proceedings were instituted in no less than 98 instances for keeping bulls without licences after they had reached the age of 10 months.

8. So much for the general position so far as it is shown by the evidence of the schemes in force and of the official statistics. These do not, however, reveal the whole situation. There is no doubt whatever in the mind of the Committee that the store stock from many of our store raising districts is of poor quality. Our information from Wales and other districts is that there is still too much use being made of the milk bull and the cross-bred bull in dairy herds and that the consequent young stock available for stores for beef—coming forward, too, in greater numbers—is in these cases deplorable. One mistake in an inferior bull being licensed or approved under the Licensing of Bulls regulations or one contravention by keeping an unlicenced bull may leave a whole district with poor stock for some time to come. There is no greater cost to the farmer in using an average good bull than a poor one, and when it comes to raising the calves for stores, poor and unthrifty stock costs more to fatten than good ones.

9. The Standing Committee considers that the situation will be met in the country if individual farmers take note of the facts as herein outlined and do their utmost to improve their own position in the matter. Owners of dairy herds who do not rear their own calves can at once effect improvement by the use of good beef or dual-purpose bulls where inferior ones are now being used. In self-contained dairy herds the problem is

different, and there the suitable step to take appears to be to see that no bull dairy calves go forward into store stock channels. It may help, also, to link up the payment of premiums on milk from accredited-producer herds with a requirement for the producer to use an approved bull; where he does so, means ought to be found to permit him, under the Milk Marketing Scheme, to use increasing quantities of milk for calf feeding, and, in cases of milk to be sold for other than liquid consumption, to send away the cream only, keeping the skimmed milk for his stock. It is important to him in this connexion that young stock will usually fetch a better price if it can be stated that they are the progeny of a quality beef bull.

10. A further point is that, when fat stock is finished and sold under the Livestock Subsidy Scheme, the success of the breeding and feeding should be noted by the breeders, as well as the feeders, and their attention drawn to outstanding points of importance which may affect their future practice, either as breeders or feeders. This would probably come as a direct result of closer contact between the officers of the Livestock Commission and those employed in relation to the Livestock Improvement Scheme.

November 22, 1938.

MISCELLANEA

Centenary of Rothamsted

In just over four years' time, i.e., 1943, the Rothamsted Experimental Station will attain its centenary. Its long record of useful work needs no emphasis in this JOURNAL. Although the field work of the Station is now adequately provided for, its work in other directions is hampered by the insufficiency of the laboratories and equipment. It is, therefore, proposed to celebrate the centenary by improving these and the farm buildings so that they may be adequate to meet the heavy and increasing demands that are now made on the Station. For this purpose subscriptions are invited with a view to raising a fund of £125,000, which is to be laid out as follows:—Laboratories, farm buildings, etc., £33,000; Library building, £20,000; new block for Imperial Bureau of Soil Science, Conference Hall, etc., £30,000; Endowment Fund, etc., £42,000. Towards this fund a sum of £34,000 has already been subscribed including gifts from H.M. the King and H.R.H. the Duke of Kent. Subscriptions should be addressed to the Director, Sir E. J. Russell, from whom further particulars can be obtained.

Seed Potatoes

About 90 per cent of the potato acreage grown in Great Britain is still planted with varieties which have been on the market for twenty years or more.

Potato growers who are considering the purchase of seed

for next year's planting will be well advised to take into account the possible advantage of growing some of the newer kinds. A number of the old varieties not only show faults such as poor shape, indifferent cooking quality and proneness to second growth, but are susceptible to Wart Disease.

The National Institute of Agricultural Botany has, for the last 18 years, been carrying out careful trials of all the new types as they have appeared during this period, full attention being paid to yield, cooking quality and other desirable characters. No new variety is recommended by them which is not *immune from Wart Disease and satisfactory in other ways*.

The Institute issues a leaflet, revised from time to time, describing the best of these newer types and making recommendations as to which of the older varieties they might profitably replace. A new edition of this leaflet—which can be obtained, free of charge, either through the County Agricultural Authority or direct from the N.I.A.B., Cambridge—is now available. The following notes, based on the fuller information contained in the leaflet, may be of interest.

NEW VARIETIES. *Arran Pilot* is confidently recommended as a substitute for Epicure, Ninetyfold, Duke of York, and Sharpe's Express. The flesh and skin are white; the tubers are of an excellent kidney shape and not prone to cracking or second growth; the eyes are shallow and cooking quality good. It is a good cropper and early bulker. It is, however, somewhat susceptible to virus disease and it is essential to obtain healthy seed. To maintain healthy seed in England, growers should obtain details of the work carried out by the N.I A B. at Ormskirk on the production of reasonably virus-free seed in Lancashire.

Doon Early is recommended as a substitute for Epicure. It has a white skin and white flesh and is blunt oval in form. It bulks several days earlier than any other variety in commerce and is an eminently suitable variety to grow for the opening of the first-early trade.

Dunbar Rover, a recent introduction suitable for lifting in mid-season, can be recommended to replace the old variety British Queen. It is a white oval with shallow eyes and of excellent quality.

Gladstone, a variety similar to King Edward in maturity and colour of tubers, has recently been grown with considerable success in many districts. The tubers are oval in shape and the cooking quality is outstanding.

Redskin is suggested as a substitute in districts where Kerr's Pink is grown. In colour and shape the tubers are similar to those of Kerr's Pink, though the eyes are more shallow. Cooking quality and cropping power are good, and it has advantages over Kerr's Pink in being some three weeks earlier and in not being subject to second growth.

Dunbar Standard is a late maincrop with white skin and white flesh, kidney-shaped tubers and shallow eyes. It is a heavy cropper of excellent quality.

It is suggested that growers plant at least small quantities of

some of the newer kinds, so that they can test for themselves the value of the recommendations made.

Marketing Notes

Milk Industry Bill. Following upon the introduction of the Milk Industry Bill* into the House of Commons on November 16, 1938, the Prime Minister made the following statement in the House on December 1, 1938:—" In view of the objections which have been raised in many quarters, the second reading of the Milk Industry Bill will be postponed pending further discussion and re-examination of the whole milk problem."

Bacon Industry (Amendment) Bill. On December 15, a Bill was introduced to amend the Bacon Industry Act, 1938, in three respects: (*a*) to provide for the modification of the standard bacon prices prescribed in the Act so as to include an allowance in regard to variations of lard prices; (*b*) to widen the provisions affecting the identification of imported pigs and carcasses used for curing; and (*c*) to enable bacon to be weighed in bulk instead of by individual pieces, for the purpose of proving claims in respect of payments to the Exchequer by curers or by curers to the Exchequer. Retrospective effect is given to these provisions.

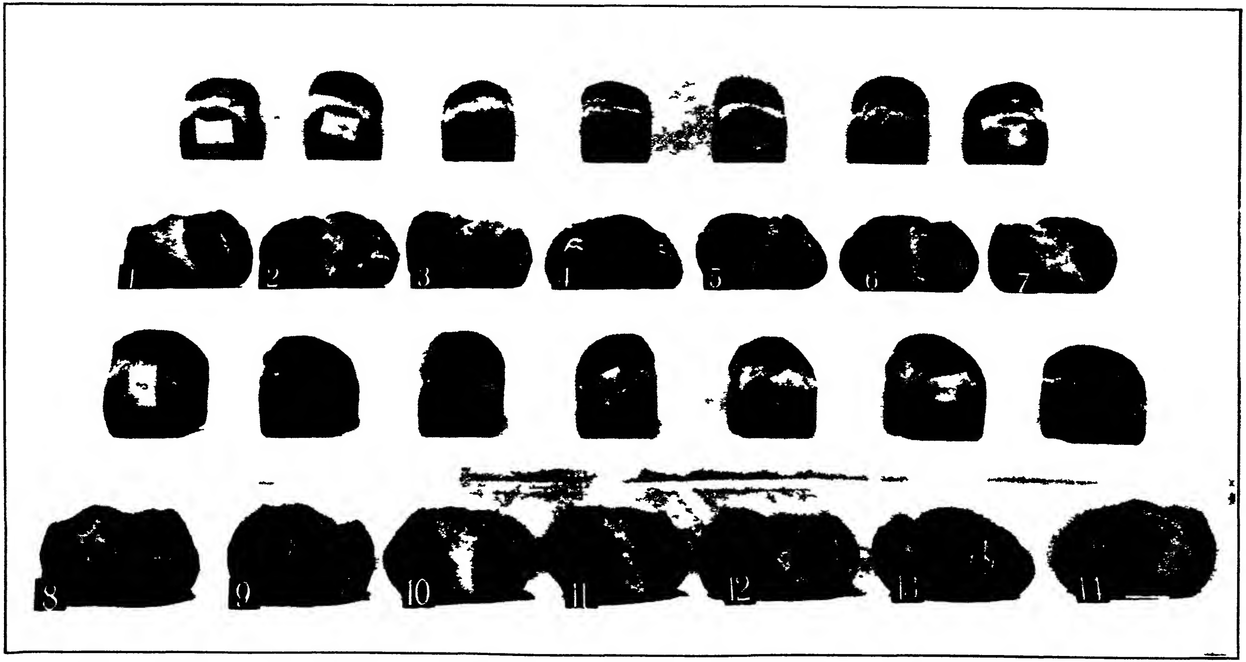
Home-grown Wheat Flour for Bread Making. The National Bakery School has this year again conducted bread-making tests with National Mark All-English (Yeoman) Straights Flour. The tests, which were made with 14 samples of flour milled from 1938 crop wheat by millers in various parts of the country, indicated that in every instance satisfactory bread was produced from the samples tested. Photographs of the test loaves are shown on the accompanying inset.

The following observations are taken from the Director's report:—

1. Most of the flours possessed a good colour and so produced bread with a creamish crumb. The uniformity of crumb colour was even more marked than last year.
2. All the flours produced most stable doughs when given their correct water absorption. Some flours, however, would only carry 14½ gallons per sack compared with 15 gallons for other samples.

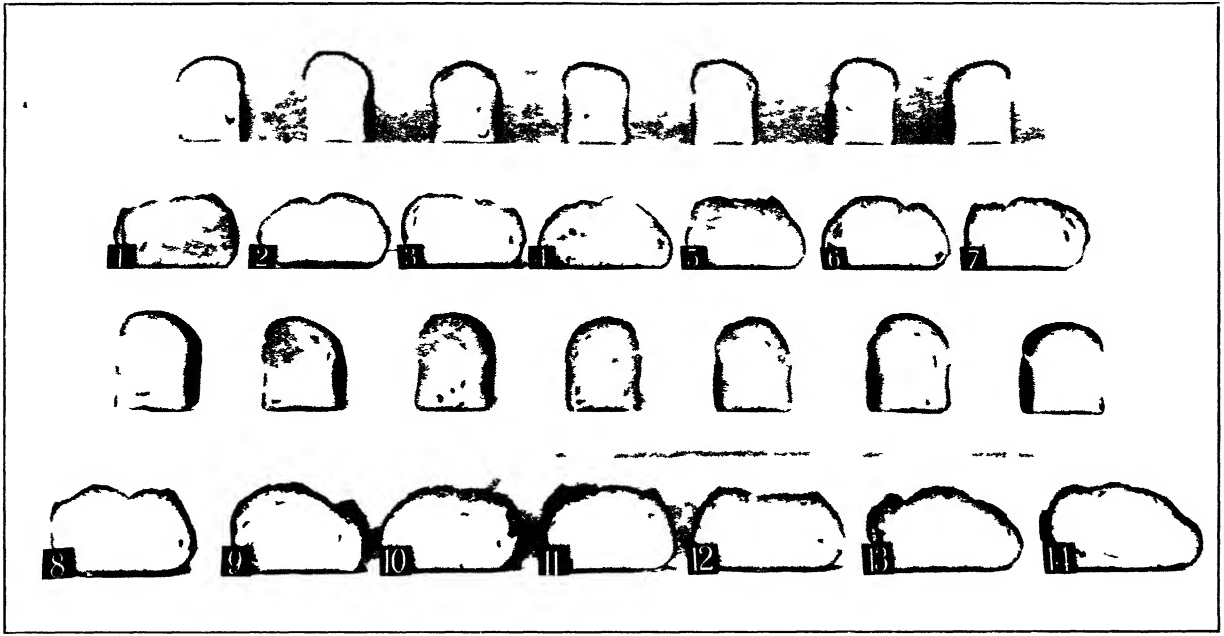
   All the doughs gassed well during fermentation and possessed good handling properties.
3. Following the practice of previous years, a 2½ bulk dough fermentation process was employed. All the flours produced good bread on this process.

* The provisions of the Bill as introduced were explained in last month's issue of this JOURNAL, pages 865–7.



Bread making Tests carried out by the National Bakery School with samples of National Mark All English (Yeoman) Straights Flour milled from 1938 crop Wheat. The test loaves uncut.

To face p. 1070



Breadmaking Test, [illegible] Straight Flour
[illegible]

4. As will be seen from the photographs, all the flours produced bread of good volume, and were quite satisfactory for oven bottom bread.
5. The stability of the flour was better than last year, and this was particularly reflected in the crumb of the finished bread.

Copies of Marketing Leaflet 12e, giving the recipe for using National Mark flour in commercial bread-making, may be obtained from the Ministry free of charge.

RECENT OFFICIAL PUBLICATIONS

The Ministry's Advisory Publications. Since the date of the list published in the October, 1938, issue of this JOURNAL (p. 731), the undermentioned Advisory Publications have been issued by the Ministry.

BULLETINS:

No. 1.—Some Diseases of Farm Animals. (8th Edition.) 2*s*. (2*s*. 3*d*. post free).

In the main reproduces its predecessor, but certain sections have been revised as necessary, and opportunity has been taken to amend the opening section in the light of recent important legislation.

No. 41.—Weeds of Grass Land. (2nd Edition.) 5*s*. (5*s*. 6*d*. post free).

Largely re-written and includes the latest information on the use of chemical substances and sprays in the control and eradication of weeds.

No. 75.—Poisonous Plants of the Farm. (2nd Edition). 2*s*. (2*s*. 3*d*. post free).

Revised in the light of the latest available knowledge.

No. 86.—Handbook of British Breeds of Live Stock. (6th Edition.)

An illustrated account of British breeds of horses, cattle, sheep, pigs and goats. Very largely re-written with the assistance of the relative Breed Societies.

No. 109.—Commercial Flower Production. Part II: Summer Flowers. 1*s*. 6*d*. (1*s*. 8*d*. post free).

This Bulletin forms Part II of the attractive series of Bulletins devoted to the cultivation of flowers for market.

No. 114.—Bovine Contagious Abortion. 4*d*. (5*d*. post free).

Outlines measures for its control and eradication.

Copies of the above are obtainable at the prices mentioned from the Sales Offices of H.M. Stationery Office or through any bookseller.

ADVISORY LEAFLETS:

No. 92.—Fumigation with Hydrocyanic Acid Gas. (Revised.)
No. 95.—Foot Rot of Sheep. (Revised.)
No. 154.—Fruit Tree Capsids. (Revised.)

Copies of any of the above-mentioned leaflets may be purchased from H.M. Stationery Office, York House, Kingsway, London, W.C.2, or at the Sale Offices of that Department at Edinburgh, Manchester, Cardiff, and Belfast, price 1*d*. each net (1½*d*. post free), or 9*d*. net per doz. (10*d*. post free).

Single copies of not more than 20 leaflets may, however, be obtained, free of charge, on application to the Ministry. Further copies beyond this limit must be purchased from H.M. Stationery Office, as above.

A list of the Ministry's publications, including bulletins and leaflets on agriculture and horticulture, may be obtained free and post free on application to the Ministry.

PRICES OF ARTIFICIAL MANURES

Description	Average prices per ton (2,240 lb.) during week ended Dec. 14th.				
	Bristol	Hull	L'pool	London	Costs per Unit ¶
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½%) .. *	8 0c	8 0c	8 0c	8 0c	10 4
" " Granulated (N. 16%) *	8 0c	8 0c	8 0c	8 0c	10 0
Nitrate of Lime (N. 13%) .. *	7 7e	7 7e	7 7e	7 7e	11 4
Nitro-Chalk (N. 15½%) .. .. *	7 10c	7 10c	7 10c	7 10c	9 9
Sulphate of Ammonia :— Neutral (N. 20 6%) .. .. *	7 9c	7 9c	7 9c	7 9c	7 3
Calcium Cyanamide (N. 20 6%) *	7 14d	7 14d	7 14d	7 14d	7 6
Kainite (Pot. 14%) .. .. §	2 18	2 15	2 15	2 15	3 11
Potash Salts (Pot 30%) .. §	5 4	5 1	5 0	5 1	3 5
" " (Pot. 20%) .. §	3 15	3 12	3 12	3 12	3 7
Muriate of Potash (Pot 50%) .. §	8 10	8 8	8 5	8 8	3 4
Sulphate " " (Pot. 48%) .. §	10 2	10 0	9 17	10 0	4 2
Basic Slag (P A 15¾%) .. §	2 12b	2 5b	—	2 10b	3 2
" " (P A. 14%) .. .. §	2 8b	2 0b	2 0b	2 6b	3 3
Grd Rock Phosphate (P.A 26–27½%) .. .. .. §	3 5a	3 0a	2 15a	2 10a	1 10
Superphosphate (S P.A. 16%) .. §	3 4	—	3 2f	2 19g	3 9
" (S P A. 13¾%) §	3 1	—	2 19f	2 16g	4 1
Bone Meal (N 3¾%, P A 20½%) §	—	7 5	7 0h	6 17	—
Steamed Bone Flour (N ¾%, P A. 27½–29¾%) .. .. §	4 12i	4 15	4 7h	4 10	—

Abbreviations · N = Nitrogen ; P.A. = Phosphoric Acid ;
S P.A. = Soluble Phosphoric Acid , Pot = Potash

* Prices are for not less than 6-ton lots, at purchaser's nearest railway station unless otherwise stated. Unit values are calculated on carriage-paid prices.

§ Prices are for not less than 2-ton lots, nett cash for prompt delivery, f o.r., in town named, unless otherwise stated. Unit values are calculated on f o r prices.

a Prices for 4-ton lots f o r. Fineness 85% through standard sieve.

b Prices for 6-ton lots. Prices at Bristol are f o r. Bridgwater , at Hull and Liverpool f o r neighbouring works and at London f.o.r. at depots in London districts Fineness 80% through standard sieve.

c For lots of 4 tons and under 6 tons the price is 1*s.* per ton extra, for lots of 2 tons and under 4 tons, 5*s* per ton extra, for lots of 1 ton and under 2 tons, 10*s.* extra and for lots of 2 cwt. and under 1 ton, 20*s.* extra.

d Delivered in 5-ton lots at purchaser's nearest railway station. For lots of 2 tons and under 5 tons the price is 5*s.* per ton extra, for lots of 1 ton and under 2 tons, 10*s.* per ton extra and for lots of 4 cwt. and under 1 ton, 20*s.* extra.

e For lots of 4 tons and under 6 tons the price is 1*s.* per ton extra, for lots of 2 tons and under 4 tons 5*s.* per ton extra, for lots of 1 ton and under 2 tons 7*s.* 6*d.* per ton extra, and for lots of under 1 ton 20*s.* extra

f Prices shown are f o r. Widnes.

g Prices shown are ex works London ; f o.r. southern rails, 1*s.* 3*d.* extra.

h Prices shown are f o.r. Appley Bridge

i Price shown is f.o r. Newport, Mon.

¶ *These are calculated by regarding a ton as comprising* 100 " *units* " (*equal parts of* 22.4 *lb.*) *so that a fertiliser, for example, with* 16 *per cent. nitrogen contains* 16 *such* " *units* " *in a ton. Then, if the price per ton of such a fertiliser be divided by the percentage figure, the deduced cost is that of a* " *unit* " *of that agent. Those in the table above are based on London prices.* (*For further explanation, see Advisory Leaflet, No.* 146, " *The Valuation of Artificial Manures,*" *obtainable from the Ministry, free of charge.*

PRICES OF FEEDING STUFFS

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Wheat, British	4 3	0 9	3 14	72	1 0	0·54	9·6
Barley, British Feeding	5 10	0 8	5 2	71	1 5	0·76	6·2
„ Canadian No. 3 Western	6 3	0 8	5 15	71	1 7	0·85	6·2
„ American ..	5 12†	0 8	5 4	71	1 6	0·80	6·2
„ Persian ..	5 13*	0 8	5 5	71	1 6	0·80	6·2
„ Russian ..	6 3	0 8	5 15	71	1 7	0·85	6·2
Oats, English, white ..	6 8	0 9	5 19	60	2 0	1·07	7·6
„ „ black and grey	6 7	0 9	5 18	60	2 0	1·07	7·6
„ Canadian, No. 3 Western	6 7§	0 9	5 18	60	2 0	1·07	7·6
„ „ mixed feed	5 12	0 9	5 3	60	1 9	0·94	7·6
„ „ No. 1 ·	6 5*	0 9	5 16	60	1 11	1·03	7·6
„ „ No. 2 ·	6 13	0 9	5 4	60	2 1	1·12	7·6
Maize, American ..	6 2	0 7	5 15	78	1 6	0·80	7·6
„ Argentine ..	6 5	0 7	5 18	78	1 6	0·80	7·6
„ Danubian, Gal. Fox	6 0†	0 7	5 13	78	1 5	0·76	7·6
Beans, English, Winter	6 0§	0 18	5 2	66	1 7	0·85	19·7
Peas, English, blue ..	9 10§	0 15	8 15	69	2 6	1·34	18·1
„ Japanese ..	21 10†	0 15	20 15	69	6 0	3·21	18·1
Dari	8 0†	0 8	7 12	74	2 1	1·12	7·2
Milling Offals :—							
Bran, British ..	5 15	0 16	4 19	43	2 4	1·25	9·9
„ Broad ..	6 5	0 16	5 9	43	2 6	1·34	10·0
Middlings, fine, imported	5 10	0 13	4 17	69	1 5	0·76	12·1
Weatings‡	5 12	0 14	4 18	56	1 9	0·94	10·7
„ Superfine‡	6 0	0 13	5 7	69	1 7	0·85	12·1
Pollards, imported ..	5 5	0 14	4 11	50	1 10	0·98	11·0
Meal, barley	7 2	0 8	6 14	71	1 11	1·03	6·2
„ „ grade II	6 10	0 8	6 2	71	1 9	0·94	6·2
„ maize	6 15	0 7	6 8	78	1 8	0·89	7·6
„ „ South African	6 5§	0 7	5 18	78	1 6	0·80	7·6
„ „ germ ..	6 12	0 11	6 1	84	1 5	0·76	10·3
„ locust-bean ..	7 7	0 6	7 1	71	2 0	1·07	3·6
„ bean	9 12	0 18	8 14	66	2 8	1·43	19·7
„ White-fish ..	15 12	2 5	13 7	59	4 6	2·41	53·0
„ Soya-bean (extracted)‡	8 7	1 11	6 16	64	2 1	1·12	38·3
Maize, cooked, flaked	7 5	0 7	6 18	84	1 8	0·89	9·2
„ gluten feed ..	6 15	0 13	6 2	76	1 7	0·85	19·2
Linseed cake—							
English, 12% oil ..	9 12	1 1	8 11	74	2 4	1·25	24·6
„ 9% „ ..	9 0	1 1	7 19	74	2 2	1·16	24·6
„ 8% „ ..	8 15	1 1	7 14	74	2 1	1·12	24·6

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Cottonseed cake, English, Egyptian seed, 4½% oil ..	6 0	0 19	5 1	42	2 5	1·29	17·3
Cottonseed cake, Egyptian, 4½% oil ..	5 10	0 19	4 11	42	2 2	1·16	17·3
Cottonseed cake, decorticated, 7–8% oil	7 7†	1 9	5 18	68	1 9	0·94	34·7
Cottonseed meal, decorticated, 7–8% oil	8 0†	1 9	6 11	70	1 10	0·98	36·8
Coconut cake, 5–6% oil	7 5	0 18	6 7	77	1 8	0·89	16·4
Ground nut cake, decorticated, 6–7% oil	8 7*	1 9	6 18	73	1 11	1·03	41·3
imported decorticated, 6–7% oil	7 0	1 9	5 11	73	1 6	0·80	41·3
Palm-kernel cake, 4½–5½% oil	7 10†	0 12	6 18	73	1 11	1·03	16·9
Palm-kernel cake meal, 5½% oil	7 12†	0 12	7 0	73	1 11	1·03	16·9
Palm-kernel meal, 1–2% oil	6 15	0 13	6 2	71	1 9	0·94	16·5
Feeding treacle ..	5 0	0 8	4 12	51	1 10	0·98	2·7
Brewers' grains, dried ale	5 17	0 11	4 6	48	1 9	0·94	12·5
Brewers' grains, dried porter	5 10	0 11	4 19	48	2 1	1·12	12·5
Dried sugar-beet pulp..	From £5 7s. 6d. to £5 12s 6d. per ton, ex factory (according to factory)						

* At Bristol § At Hull. † At Liverpool.

‡ In these instances manurial value, starch equivalent and protein equivalent are provisional.

NOTE: The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of November, 1938, and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative values of the feeding stuffs on offer at their local market by the method of calculation used in these notes Thus, if linseed cake is offered locally at £11 per ton, then since its manurial value is £1 1s. per ton as shown above, the cost of food value per ton is £9 19s. Dividing this figure by 74, the starch equivalent of linseed cake as given in the table, the cost per unit of starch equivalent is 2s. 8d. Dividing this again by 22·4, the number of pounds of starch equivalent in one unit, the cost per lb. of starch equivalent is 1·43d. Similar calculations will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own markets. The figures given in the Table under the heading "manurial value per ton" are calculated on the basis of the following unit prices:—N., 7s. 5d.; P_2O_5, 2s. 6d.; K_2O, 3s. 8d.

FARM VALUES OF FEEDING STUFFS

The prices in respect of the feeding stuffs used as bases of comparison for the purpose of this month's calculations are as follow:—

	Starch equivalent Per cent.	*Protein equivalent Per cent.*	*Per ton £ s.*
Barley (imported)	71	6·2	5 18
Maize	78	7·6	6 5
Decorticated ground-nut cake ..	73	41·3	7 13
„ cotton-seed cake ..	68	34·7	7 7

(Add 10*s*. per ton, in each instance, for carriage.)

The Table below is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values," which it is recommended should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows, are given in the December, 1938, issue of the Ministry's Journal, p. 965.)

FARM VALUES

Crop	Starch equivalent	Protein equivalent	Foor value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	6 10
Oats	60	7·6	5 8
Barley	71	6·2	6 5
Potatoes	18	0·8	1 11
Swedes	7	0·7	0 12
Mangolds	7	0·4	0 12
Beans	66	19·7	6 12
Good meadow hay	37	4·6	3 7
Good oat straw	20	0·9	1 14
Good clover hay	38	7·0	3 11
Vetch and oat silage ..	13	1·6	1 3
Barley straw	23	0·7	1 19
Wheat straw	13	0·1	1 2
Bean straw	23	1·7	2 0

PROGRESS OF THE LAND FERTILITY SCHEME

The number of applications for contributions under the Land Fertility Scheme received from occupiers of agricultural land in the United Kingdom now exceeds 303,000. The quantities of lime and basic slag in respect of which these applications have been made are approximately 2,193,000 of lime and 585,000 tons of basis slag.

APPOINTMENTS

COUNTY AGRICULTURAL EDUCATION STAFF: ENGLAND

Berkshire: Miss M. Massey, N.D.D., has been appointed Assistant Instructress in Dairying *vice* Mr. G. T. Chalmers, N.D.D.

Mr. T. A. Willis has been appointed Assistant Instructor in Agriculture.

Cumberland and Westmorland: (Joint Staff): Miss S. L. Corner, B.Sc., N.D.D., has been appointed Itinerant Dairy Instructress *vice* Miss L. C. Ball, N.D.D.

Mr. J. Hodgson, B.Sc., has been appointed Warden and Recorder *vice* Mr. W. C. Watson, P.A.S.I., N.D.D.

Hampshire: Mr. R. P. Feltwell, N.D.P., has been appointed Assistant Instructor in Poultry-keeping (Farm Institute) *vice* Mr. N. R. C. Chaplin, N.D.P., C.D.P.

Mr. F. W. Shepherd, N.D.H., and Mr. H. Taylor, N.D.H., have been appointed Assistant Instructors in Horticulture *vice* Mr. J. J. O'Carroll and Mr. C. P. Quarrell, B.Sc., respectively.

Isle of Wight: Mr. C P. Barrett, N.D.H., has been appointed Instructor in Horticulture to fill the vacancy caused by the retirement of Mr. C. Martin in September, 1936.

Somerset: Mr. W. H. Lewis, R.H.S. (Certs.), N.D.H. (Prelim.), has been appointed Instructor in Horticulture *vice* Mr. H. J. Ward, N.D.H.

Mr. F. R. Wallbutton has been appointed Chief Instructor in Poultry-keeping *vice* Mr. H. H Duckett, N.D.P., L.D.A.

Suffolk, East: Mr. W. H G. Blacker, N.D.A., has been appointed Junior Agricultural Assistant *vice* Mr. F. W. Dunnett, N.D.A.

FARM WORKERS' MINIMUM RATES OF WAGES

Agricultural Wages Board At a meeting held on December 13, Orders were made continuing the minimum rates of wages unchanged in the following areas (the figures quoted being the minimum weekly wages for ordinary adult male workers): Berkshire (33*s.* 6*d.*), Cambridgeshire and Isle of Ely (35*s*), Derbyshire (38*s.*), Dorset (34*s.*), Herefordshire (34*s.*), Norfolk (34*s.* 6*d.*), and Surrey (34*s.* 6*d.*), while in Cornwall the wage is increased by 6*d* to 34*s.* 6*d.* and in Buckinghamshire and Wiltshire by 1*s* to 35*s.* 6*d.* and 34*s.* 6*d.* respectively. The Orders for Herefordshire and Surrey include the first directions made by Agricultural Wages Committees under the Holidays with Pay Act, the Hereford Committee having directed 6 days' holiday for workers employed or engaged to be employed by the same employer from January 1 to December 31, 1939, and 3 days where the employment extends for 6 months or more but less than 12, and the Surrey Committee, 7 days' holiday for regular workers who, at any date between December 25, 1938, and December 23, 1939, complete 12 months' service and 4 days where 9 months' service is completed. In both instances holiday remuneration is fixed at daily rates proportionate to the minimum rates. For full details of the minimum rates and of the various provisions connected with them, reference should be made to the Orders, copies of which may be obtained free of charge from the Secretary, Ministry of Agriculture and Fisheries, King's Buildings, Smith Square, London, S.W.1.

Enforcement of Minimum Rates of Wages. During the month ending December 8, 1938, legal proceedings were taken against 3 employers for

failure to pay the minimum rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases follow :—

Committee Area	Court	Fines Imposed	Costs Allowed	Arrears of Wages Ordered	No. of Workers Involved
		£ s. d.	£ s. d.	£ s. d.	
Cardigan ..	Llanilar	(a)	2 10 0	6 0 0	1
" ..	" .	3 0 0	2 2 0	25 0 0	1
Yorks. E.R.	Beverley .	2 0 0	0 5 0	42 14 6	2
	Totals .	5 0 0	4 17 0	73 14 6	4

(a) Dismissed under the "Probation of Offenders" Act

FOOT-AND-MOUTH DISEASE

Nine outbreaks of foot-and-mouth disease were confirmed during the period November 21 to December 20, of which three, viz., at Llancarfan, Glamorgan, on November 22; at Rhiwbina, Glamorgan, on November 27; and at Bonvilston, Glamorgan, on November 29, were in the Infected Area that already existed around Bonvilston.

The imposition of Infected Area Restrictions on areas each of approximately 15 miles radius round the Infected Place was rendered necessary by outbreaks of disease at Longham, Dorset, on November 23; at Little Marlow, Bucks, on November 28; at Stalbridge, Dorset, on December 5, and at Rowsham, Bucks, on December 9.

NOTICES OF BOOKS

Grassland Management for the Practical Farmer. By W R Peel D.S.O., M.A., F.L A.S., P.A.S.I. With a foreword by Professor R. G. Stapledon, C.B.E, M.A. Pp. xv + 191. (London · Macmillan & Co., Ltd. 1938. Price 7*s.* 6*d.*)

This authoritative book is written for farmers, by a farmer, and above all it is practical and based upon many years of actual experience Colonel Peel has found that some grasses grow fast, others are sluggish and unproductive, some are relished by stock, others rejected, some are leafy, others stemmy, some grow tall and some live prostrate. The herbage association loosely called "grass" is a democracy and one that has to be managed with understanding. Habits and foibles of the individual species are amply described in the book, and if the farmer will but learn to know his grasses and clovers—and his weeds—the reasons underlying successful management will be clear.

The author shows how man and nature have evolved what are regarded as the seven fixed types of this country's herbage by good treatment or by bad, and that man can still make or mar them. He deals with all the factors contributory to pasture deterioration, such as over-grazing the luxuriant growth in spring and under-grazing in summer, general neglect of cultivation and manuring which results in the matted pastures found, for example, on hill tops and near many industrial areas. The various methods used to correct the results of mismanagement and in

the improvement of poor pasture are described from experience gained in reclaiming poor hill pastures in Wales and elsewhere.

Guiding principles are laid down for grass production, for control of grazing to ensure continuous productivity, for obtaining an early bite, for manuring pastures and for management of land for hay, for silage and for grass to be laid up for the drier.

The appendices, dealing with the values of various pastures at different times of the year, the feeding values of produce conserved from grass land and other crops, and silage making by modern methods, together form a useful collection of material which has not hitherto been readily available.

Intensive Salad Production. By C. P. Quarrell. Pp. 235. Illus. (London: Crosby Lockwood. 1938. Price 10*s.* 6*d.*)

The author shows commendable courage in tackling such an intricate subject. His caution, however, is sometimes extreme and his preliminary chapters modelled on what now appears to be the inevitable introduction to any horticultural publication may be felt to delay unduly the principal subject-matter of the book.

Much of the information has, of course, appeared before, but here we have all the different phases of the work collected together by a man who writes with that assured touch that can only come from practical experience.

The chapters on the different systems are good, but might have been improved by a more liberal supply of diagrams and tables, which are so useful for reference. More specific information on manuring would also have been welcomed. There is a very complete yet concise chapter on diseases and pests, with numerous references, which have been restricted to a very few publications—a wise procedure in a "practical" book.

The book is one of the series of "Handbooks" published by Messrs. Crosby Lockwood under the editorship of Mr. H. C. Long. It is attractively presented and illustrated by some excellent photographs.

It should prove a great help to the student or beginner and a welcome reference book to the more practised.

Silage and Crop Preservation. By S. J. Watson, D.Sc., F.I.C. Pp. x + 192. (London: Macmillan & Co. Price 7*s.* 6*d.*)

Dr. Watson makes out a case for crop conservation to provide an alternate source of home-produced feeding stuffs, a matter both of national importance and of economic benefit to the farmer. The whole aim of crop conservation is to produce not a roughage but a feeding stuff of high protein value which will replace part at least of the imported concentrates and save some of the valuable grass which now goes to hay.

After describing the various methods of haymaking and emphasizing the wastefulness of the process, the author champions the cause of ensilage which can be made in the wettest of weather. He explains very clearly what happens to a green crop when it is ensiled under different conditions in soil pit, stack or solid container, and how rapid advances in our knowledge of the processes at work have made it easy to prepare a fodder with a very much higher feeding value than hay.

The modern tendency is away from the high tower silos to the use of cheap portable silos which can be knocked up on the farm. Complete instructions for building and filling of silos are given.

The feeding value of silage is the crux of the question and a mere glance at Dr. Watson's table of comparisons is enough to show the commanding place of silage in comparison with hay. How closely the feeding value of

its dry matter rivals that of artificially dried grass will probably cause some surprise. An important point is the addition of minerals to silage during making. This can be done without affecting the efficiency of the process and can be adapted to local conditions. Dr. Watson foresees the day when the making of silage in small portable silos may be the salvation of hill farmers who commonly experience losses from mineral-deficiency diseases.

Chapters on the relative value of various conservation processes, and on the relation of conservation to permanent grass land and its management will repay careful study, while further chapters enumerate crops and crop residues suitable for conservation.

Poultry Husbandry. By M. A. Jull. Second Edition. Pp. viii + 548. Illus. (London: McGraw-Hill Publishing Co., Ltd. 1938. Price 24*s*.)

The American poultry industry, along with those of many European countries, has experienced within the last decade a remarkable expansion, which to some considerable extent has been encouraged by the promotion of organized poultry instruction, investigation and research. Mr. Jull, who, before he took up his present duties at the Maryland University as Professor of Poultry Husbandry, filled the responsible position of Senior Poultryman of the U.S.A. Department of Agriculture, gives us ample evidence in his book, which has now reached a second edition, of his unrivalled knowledge and experience of American methods. His work generally covers a very wide field, and may claim to embrace almost every aspect of poultry keeping from hatching to the economics of production and marketing. Although, as might be expected, many of the methods described appeal more particularly to American farmers, the discussion of fundamental principles and the extensive reviews of various lines of research, which in this second edition have been brought right up to date, must prove of both interest and value to a very large number of readers: such readers might with advantage include not only the poultry farmer, but students, poultry Advisory Officers and investigators.

Animal Life in Fresh Water. By Helen Mellanby. With a foreword by Professor L. E. S. Eastham. Pp. viii + 296 and 210 figures. (London: Methuen & Co., Ltd. 1938. Price 8*s*. 6*d*.)

This book has long been needed. Hitherto there has been no work on the British freshwater fauna to which the beginner could refer to identify even approximately the animals he might find.

Mrs. Mellanby describes all the groups of invertebrates which occur in British freshwaters in as much detail as can be expected in a volume of this size. In the small well-known groups, such as the Tricladida and Hirudinea, all the British species are described, but this is naturally not possible in the larger groups, such as Coleoptera and Diptera, where the descriptions generally stop at the families, though sometimes continued to the genera. All the groups are profusely illustrated with clear line drawings, and the text and picture together should enable anyone to classify approximately most of the invertebrates found in our fresh waters. For those who wish for more detailed information and identifications there are given, after the description of each group, references to systematic works on it.

Since lakes and ponds are much better known than flowing waters, it is not surprising that there are some errors and omissions in the groups found particularly in rivers.

These and other errors noted do not detract seriously from the value of the book, but it is hoped that they will be attended to when the new edition that is certain to be called for is prepared. Mrs. Mellanby must

certainly be congratulated on a very satisfactory production which does indeed satisfy a "long felt want."

Food and Health. An Introduction to the Science of Nutrition. By A. Barbara Callow, M.A. (Cantab), M.Sc. (London), M.S. (Yale). Second edition. Pp. 168. Illus. (Oxford: Clarendon Press. 1938. Price 5s.)

In view of the increasing interest in the subject of human nutrition and of the advance in knowledge, particularly of the vitamins, in the last ten years, a new edition of this excellent little book, which has been re-written and brought up-to-date, is very welcome. The book is designed to show what food factors are required and how they can be obtained. The scientific principles of diet are explained and their everyday application given. The book describes the chemical nature of food, the changes that take place during digestion, the way in which food supplies energy and warmth, and the history and significance of the vitamins. A separate chapter is devoted to the daily allowances of calories, protein, mineral elements and vitamins. There is also a discussion of the relative merits of some ordinary foods and a simplified account of what we ought to eat. The book also deals with the food requirements of mothers and children, with food as a cure for disease and with dietetic systems and food fads. Food tables are given which, for the first time, combine figures for vitamin content with those for chemical composition and the food value of most common foods. The book is written in a clear readable style, and contains information that everyone should seek to possess, especially those who wish to see the happy "marriage of nutrition and agriculture."

Wild Flowers in Britain. By R. Gathorne-Hardy. Pp. viii + 120. Illus. (London. B. T. Batsford, Ltd. 1938. Price 8s. 6d.)

There will probably be found to be a fair measure of agreement that this will rank as perhaps the most charming book on its subject that has been published in recent years. It would, of course, be foolhardy to attempt to predict its future place in the literature of "nature books," but it lies in the line of succession to such classics as White's Selborne and may well live to delight a later generation than the present. There are many floras which give all the information needed to help in identifying a flower, and there are text-books in which one may learn all the intimate goings-on of plant life. It has not been the author's intention to add, in this book, to an already sufficient supply of information. Its purpose is to instruct the amateur in the *pleasures* rather than in the science of botany; and, since these pleasures are unattainable without some knowledge, he has tried to purvey at least a minimum of necessary technical facts—enough capital, as it were, to supply a life-supporting income of delight.

Best of all, Mr. Gathorne-Hardy has succeeded in the rare achievement of communicating his own pleasure in wild flowers to his readers.

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NOTES FOR THE MONTH

Produce of Crops

Owing to demands on space, the following statement of the produce of the principal crops in England and Wales in 1938 was unavoidably omitted from our January issue. Although the figures will be familiar to some of our readers, it may be convenient to give the particulars here for purposes of reference.

The areas under all crops in June, 1938, with the exception of turnips and swedes and the hay crops, were greater than those returned for the same crops in June, 1937. The acreages under wheat and barley were the largest since the years 1922 and 1932 respectively, but the area devoted to oats was, with the exception of that of last year, the lowest on record. The area under " seeds " hay was also the lowest recorded, and the area under meadow hay was the smallest returned since 1921.

With the exception of mixed corn and beans, the yields per acre of the corn crops were greater than in 1937, and in the case of wheat and barley the yields were the highest recorded since returns were first collected in 1885. The yield of oats reached the high level of 1928, 1929 and 1933. Potatoes and turnips and swedes also yielded better than in 1937, the yield of potatoes being the highest on record, but mangolds showed a decrease as compared with the previous year. The yields of the hay crop were particularly low, and, with the exception of the year 1893, were the lowest ever recorded.

The estimated total production of each crop, with the exception of mixed corn, mangolds and hay, was greater than in 1937. The total production of wheat was the highest since 1921, while that of barley has not been exceeded since 1929. " Seeds " hay showed the lowest total production ever

recorded, while that of meadow hay has never been lower except in the year 1893.

PRELIMINARY STATEMENT SHOWING THE ESTIMATED TOTAL PRODUCE AND YIELD PER ACRE OF THE CORN, HAY AND ROOT CROPS IN ENGLAND AND WALES IN 1938, WITH COMPARISONS FOR 1937, AND THE AVERAGE YIELD PER ACRE OF THE TEN YEARS 1928–1937

Crops	Estimated Total Produce		Acreage		Estimated Yield per Acre		
	1938	1937	1938	1937	1938	1937	Average of the Ten years 1928-1937
	Thousands of Tons	Thousands of Tons	Acres	Acres	Cwt.	Cwt	Cwt
Wheat .. .	1,855	1,393	1,830,261	1,731,833	20·3	16·1	17·6
Barley . ..	803	576	885,499	822,828	18·1	14·0	16·1
Oats	1,069	938	1,300,530	1,223,098	16·4	15·3	15·7
Mixed Corn ..	74	75	92,240	91,808	16·1	16·2	15·6
Seeds Hay* .	1,281	2,141	1,184,082	1,466,783	21·6	29·2	26·7
Meadow Hay† ..	3,131	4,967	4,229,308	4,674,995	14·8	21·2	19·7
Beans for Stock-feeding or Seed	106	83	129,817	96,322	16·3	17·2	16·3‡
Peas for Stock-feeding or Seed	30	25	38,153	33,843	15·8	14·6	14·8‡
					Tons	Tons	Tons
Potatoes ..	3,486	3,126	474,786	455,296	7·3	6·9	6.6
Turnips and Swedes ..	5,081	4,739	421,190	435,413	12·1	10·9	11·4
Mangolds ..	3,599	3,668	212,531	205,466	16·9	17·8	18·5

* Hay from Clover, Sainfoin and Grasses under rotation
† Hay from Permanent Grass.
‡ Peas and Beans harvested as Corn up to 1934

FARMING IN THE BRISTOL PROVINCE

A. W. Ling,
University of Bristol

Gloucester cheese, Hereford cattle, Somerset cider, Wiltshire bacon and Worcester asparagus. This is but a random sample of the variety of agricultural products coming from the five counties which comprise the Bristol Province under the Agricultural Advisory Scheme of the Ministry of Agriculture. No group of adjacent counties in the whole country can boast such a variety of conditions of climate, topography, geology and consequently agricultural products, and no group of counties has seen less revolutionary changes in its agriculture since the post-War depression than the five of the Bristol Province. The area concerned is roughly rectangular in shape, with Birmingham, Leominster, Chard and Salisbury at the four corners. The total acreage involved is just over 3 million, of which only 664,000 acres are under arable cultivation, 2,114,000 acres grass, the remaining 313,000 acres being rough grazing and woodlands. Of the arable land itself, approximately one-quarter is under temporary grass and clover.

The decline in arable land is general and has been the subject of much controversy for many years. All the counties of the Bristol Province have shown considerable decreases in the acreages under wheat, barley and oats from just after the War until the Wheat Act of 1932 somewhat stabilized the position. Since 1920, and in spite of the subsidies recently given to these three crops, the Province has lost about 73,000 acres of wheat, 65,000 acres of barley and 100,000 acres of oats, equivalent to one-third, two-thirds and three-fifths of the respective acreages in 1920.

From these statistics it will be seen that grass land predominates in the Province, and although much of the grass land is of good quality, much of it is still capable of great improvement both as regards quantity and quality. A very large part of the Province is deficient in lime, and some 75 per cent. of the soils are also deficient in potash and/or phosphates. It is to be hoped that the Land Fertility Scheme will be of some help in assisting farmers to correct the deficiencies in lime and phosphate, but the problem of potash deficiency is a very real one that in years to come is likely to become more acute, with resulting bad effects in the crops

The Bristol Agricultural Advisory Province

The figures in brackets are the telephone numbers of the appropriate County Agricultural Organizers and other centres connected with agricultural education and research in the Province

and stock of the area. Even to-day, districts are known in the Province where potash deficiency is a limiting factor, i.e., where crop failures occur even if the other plant foods, such as nitrogen and phosphates, are applied. This is particularly so on some of the lighter soils, such as the Wiltshire greensands and the sandy beds of the Old Red Sandstone in south-Herefordshire.

Few geological formations are absent from the Bristol

Province, and while formations do not, as a rule, give reliable indication as to soil, it may be said that the Province exhibits a great variety of soil types, indeed, it is claimed that within Somerset alone are to be found samples of nearly all the soil types of England.

Of the geological formations which are of agricultural significance in the Province, the largest block is the Old Red Sandstone. This covers almost the whole of Hereford and in the extreme west of the county rises to a height of over 2,000 ft. The soil is generally a mixture of marl with clay. In the east of the county are areas of stiff clay lands, although there are some patches of light sand. The Old Red Sandstone also stretches from Hereford into Worcester as far as the Teme Valley and the foot of the Malvern Hills. The same formation occurs in Somerset, on Exmoor, which rises in places to 1,600 ft., in the Quantocks (900-1,000 ft.). It also occurs as a nucleus in the Mendip Hills (900-1,000 ft.), but the greater part of this range consists of mountain limestone, and the burning of lime by farmers for manurial purposes used to be a considerable and profitable activity. The lowlands of Somerset are largely composed of alluvial soils which provide some of the finest grazing in the country, and of peat lands upon which the willow-growing industry is based. The marls and clays form the best wheat lands both in Somerset and in Worcester, although scarcely any of it is now under wheat. In the latter county the clay lands are fairly extensive and are found to the east of the Severn. The loamy soils are found to the west of this river, as well as in the Vale of Evesham, where soil types play such a prominent part in the cultivation of different types of fruit, hops and vegetables. The highlands of Worcester are not of much agricultural significance, but the valleys provide rich grazings.

No description of the soil of the Bristol Province would be adequate without reference to the chalk and oolitic formations. While some chalk is to be found in Somerset, especially on the Wiltshire and Dorset borders, together with some greensand, the large chalk regions are those of Salisbury Plain and the Marlborough Downs in Wiltshire. These have an altitude of between 400 and 600 ft., although small patches rise considerably higher. A fairly extensive area of greensand is found in the centre and east of Wiltshire. Salisbury Plain consists of undulating tracts with valleys in which are found the villages.

Another area somewhat similar to the Wiltshire chalk lands is the Cotswold region of approximately 300,000 acres. This region consists of fairly level tracts of country lying between 600 and 700 ft. above sea level with shallow valleys between. Underlying the thin soil known as "stonebrash" is the great and inferior oolite. Because of the stony nature of the soil, ploughing must not be carried out too often or too deep, and there is constant need for consolidation by means of rolling or treading. This soil is not very fertile naturally, but will repay careful manurial treatment. As will be shown later, the area has recently been converted from arable land into pasture at a fairly rapid rate, but it is still regarded as the chief arable area of the Province. Its claim to be an arable district rests upon a temporary basis, however, for until the rapid growth of factory towns called for larger supplies of grain, the Cotswolds were a grass-sheep area.

To the east of the Cotswold area there are about 60,000 acres of more fertile soil, lying for the greater part on Forest Marble. Part of this is overlaid with "corn brash" soil.

The most fertile land in Gloucester, however, is that which forms the Vale of Severn. Its extent is approximately 370,000 acres and for the greater part is on Lias Clay. The best patches of this land are the areas in which the clay is overlaid with Red Marl or Sandy Loam. The lower part of the Vale, near Bristol, contains New and Old Red Sandstone, with some Coal Measures.

The greatest continuous area of coal measures occurs in the Forest of Dean, although a few isolated patches are to be found in Somerset. The Forest of Dean is still well wooded and has little agricultural value.

Another fairly large area of land having less agricultural value than it should is that known as the "teart" land of Somerset. This region forms the centre of Somerset, and although the boundary line actually encloses many square miles, the teart land itself is found in patches. Up to the present, no remedy has been found for the severe "scouring" which this type of grass land causes. Sheep are unaffected by it, but cattle may die if left there; on the other hand, cattle will recover completely if removed to good pasture.

Because of its geographical position and topography, the Province has a moderately wet climate compared with the remainder of England and Wales, for it has a heavier rainfall than the Midlands and the East, but, on the other hand,

is drier than Cumberland, Lancashire, Wales, Devon and Cornwall. Over the greater part of the Province there is a mean annual rainfall of between 30 and 40 in., although the whole of Worcester and the greater (eastern) portion of Hereford have less than 30 in.

It will, no doubt, be surmised from what has been already said that in this Province farmers' main energies are devoted to dairy farming, and to milk production in particular.

Farmhouse cheesemaking had for many years provided a remunerative outlet for milk produced in excess of local liquid requirements, but owing to improved transport and to the operation of the Milk Marketing Scheme, this activity has greatly declined during recent years. Thus, of the two well-known cheesemaking areas in the Province, namely, the Gloucester (Berkeley) Vale and the centre of Somerset, only the latter area still produces cheese to any appreciable amount. The former area is famous for the Single and Double Gloucester Cheeses, the latter area for the Cheddar and Caerphilly varieties. Unfortunately, the production of Caerphilly cheese has declined recently owing to the industrial depression in South Wales.

All five counties have, however, increased the size of the dairy herd, but this increase has not been accompanied by a corresponding increase in the acreage under grass. Actually, fewer acres per cow are now required as compared with 1920, and this can only be the result of the improved management of grass land.

It is difficult to make direct comparison between the five counties because of the varying proportions of other classes of live stock, but it is noteworthy that at both dates Wiltshire has had the smallest acreage of grass per cow and has been closely followed by Somerset. Herefordshire and Worcestershire, on the other hand, have had the greatest acreage per cow.

Similar statements apply with regard to mangolds. Wiltshire at both dates has the lowest acreage of mangolds per cow, and is again closely followed by Somerset. Gloucestershire, Wiltshire and Worcestershire have had more drastic reductions in acreage per cow than the other two counties. The Province as a whole has decreased the mangold figure from 10.8 acres to 6.3 acres per 100 cows, namely, a reduction of nearly 42 per cent., while Gloucestershire and Wiltshire have almost halved their 1920 mangold acreage per cow, the

decrease being 49 per cent. in both instances. These heavy decreases raise the question of how much further the downward movement will go. If it is possible to abolish mangolds as a food for cows, then there is theoretically no need to produce mangolds to assist milk production. If cereal production is encouraged by means of quotas or subsidies, then mangolds may continue to be grown and may even increase in order to complete the crop rotation. On the other hand, other cleaning crops may be used, as for example, beet or potatoes, and it may be that the growing of mangolds will become less and less. There is no doubt that a sugar-beet factory in the south-west would be a most valuable asset and it would do much to encourage a higher level of arable farming.

One part of the Bristol Province lies within the West Midland Region of the Milk Marketing Scheme, whilst another part forms a section of the Mid-Western Region. It is, therefore, not easy to give particulars of milk production for the Bristol Province itself, but on the assumption that there are 360,000 cows producing on the average 1¾ gal. a day, the total milk production must be in the neighbourhood of 230 million gal. per annum. Although, of course, the proportion used for manufacturing purposes varies from month to month, it has been estimated that on the average over the year one-half of the total production is in excess of liquid requirements and has consequently to be used for manufacturing purposes. The proportion is greater in the south-western part of the Bristol Province, namely that part which falls within the Mid-Western Region of the Milk Marketing Scheme, than in the northern part of the Province which belongs to the West Midland Region.

The main beef area is situated in Herefordshire, although some beef cattle are carried in West Worcestershire and North Gloucestershire. West Somerset is in the beef area which includes the rich alluvial soils around Bridgwater and in the Vale of Taunton. While, however, since the War, there has been a decrease in the numbers of beef cattle carried in Somerset, Herefordshire has shown an expansion, and, given favourable prices and market conditions, it would appear that this growth can continue before saturation point is reached. The well-known tendency towards the production of younger beef cattle is strongly marked, as may be judged from the fact that, whereas in 1920 there were 118,000 cattle over two years old and 204,000 under two years, there are

now 286,000 under two years old, but only 84,000 over two years.

There are several breeds of sheep in the Bristol Province. Historically, the Mendip and Porlock breeds of Somerset, the Cotswold and the Ryeland breeds of Gloucester are the most important. With the changes in the general economy of the farm, however, occurred changes in the breeds of sheep. The Mendip breed went out of existence with the spread of the enclosure movement, for, while they were suitable to open-field farming, they were too light for the more intensive methods adopted after enclosures. The predominant breeds in Somerset to-day are the Exmoor Horn and Dorset Horn; the latter breed drops its lambs from September onwards, and so enables farmers to obtain the high prices ruling just before Christmas. It is sometimes the practice for farmers to buy ewes in lamb in August, to fatten off the lambs as soon as possible, then to fatten and sell the ewes so that all the sheep are off the farm before dairying begins in the spring.

The Cotswold breed in Gloucestershire was crossed with Leicesters in the early part of the 19th century, and this resulted in a heavy fleece. To-day the predominant breed in the Cotswolds is the Oxford Down, which is usually regarded as originating from a cross between a Cotswold ram and a Hampshire Down ewe. Sheep farming in the Cotswolds, as on the Wiltshire Down, is closely connected with cereal growing, so that the fall in the prices of cereals during recent years has caused not only a decline in the numbers of sheep, but a change from arable to grass flocks. The once famous Ryeland breed used to be prominent in that part of the Forest of Dean known as the Ryelands. The sheep were fine-woolled, but are now scarcely ever seen as a pure flock. From there, extending into Herefordshire and parts of Worcestershire, one finds the Clun Forest, Kerry Hill or Radnor breeds sometimes pure, but often crossed with Shropshire, Hampshire or other Down rams.

In the arable districts of Wiltshire the Hampshire Down is commonly used, but during recent years the increase in the acreage under grass has caused a demand for breeds of grass sheep, such as the Cheviots and Half-Breds (Border Leicester x Cheviot).

Largely on account of the cost of labour, the arable flocks of sheep have decreased even in those districts where hitherto they were thought to be an indispensable part of the rotational

system of farming. For example, just after the War the Bristol Province as a whole carried about 8 acres of swedes and turnips to every 100 sheep, whereas to-day this proportion has fallen to approximately 2½ acres. Even in Wiltshire where the light Downlands have always run arable flocks in connexion with barley production, the acreage of turnips per 100 sheep has fallen from 11 acres in 1920 to slightly under 4 acres at the present time. The total stocking of sheep in the Bristol Province to-day consists of 652,000 ewes, and 855,000 other sheep.

Pigs, poultry, market gardening and fruit growing are all important sections of agriculture in the Province and on the whole they have probably proved more remunerative than other branches of agriculture in the last decade, although the incidence of disease amongst poultry has taken a heavy toll. Cider orcharding is still prominent and much good work has been done by the National Fruit and Cider Institute at Long Ashton, the cider orchard improvement scheme of Gloucestershire and the Somerset County Instructor in Cider Making towards the general improvement of cider orchards and the manufacture of cider.

The decline in adult workers is too generally known to call for much comment, but of the 50,000 regular adult male workers in the Bristol Province just after the War, there are now only 41,000. This in itself is serious, but there is evidence everywhere that fewer and fewer youths are being regularly employed on farms, and, in consequence, the supply of trained adult labour must correspondingly diminish. This is clear from the fact that, although there were well over 17,000 youths regularly employed on farms in the Bristol Province in 1920, there are now only half that number.

This evidently means either that farm economy has been so reorganized that in future fewer boy workers to men will be required, or that these figures are a reflection of the fact that agriculture cannot maintain its supply of adult workers by the apprenticeship system, and is looking outside the industry for adult men to make good any labour shortage. It may, of course, be that both are operating.

It is difficult to forecast future trends of rural population, for there are at present several opposing economic and social forces to be considered, such as, on the one hand, the more highly-paid work in connexion with rearmament and road construction, and, on the other hand, the improved housing

and rates of wages which have been made during recent years.

In the Bristol Province, excellent facilities are provided for agricultural education, both for the adolescent and the farmer. The University of Bristol is the Provincial Agricultural Advisory Centre for the five counties of the Province. Each county in the Province has its own County Agricultural Organizer with a staff of superintendents, instructors and lecturers capable of and willing to give practical advice to farmers, horticulturists, poultrymen, bee-keepers and others, directly or indirectly concerned with agriculture in its many branches. Behind this county service is the Provincial Advisory Service at the University of Bristol, the official function of which is to provide technical advice for farmers and to investigate local problems. In the execution of its duties, the Provincial Centre here at Bristol, as elsewhere throughout the country where similar arrangements have been made by the Ministry, works in the closest possible collaboration with the County Agricultural Organizers; in point of fact, the County Organizer may be regarded as the local general practitioner, and the appropriate Advisory Officer as the specialist, to whom difficult and obscure cases are referred.

The Ministry issues a leaflet, *Technical Advice for Farmers* (Form A.705/T.G.), which gives full information with regard to this service, and farmers who have not already obtained a copy should do so at once by writing to the Secretary of the Ministry.

In addition to the Advisory service outlined above, the Bristol Province provides for the education of the young farmer and farm worker at the Royal Agricultural College, Cirencester, the Cannington Farm Institute, Nr. Bridgwater, and the Avoncroft Agricultural College, Worcester. Then, too, by outside lectures and demonstrations to farmers, Young Farmers' Clubs, Women's Institutes and the like, every effort is made by those engaged in agricultural education and research to bring to the notice of growers the most modern methods of production and disease prevention. Dauntsey's School at West Lavington, Wiltshire, although not a part of the official Agricultural Advisory service, has a very strong agricultural " side."

There are situated in the Province also two important Research Stations—the National Fruit and Cider Institute at Long Ashton, where problems concerning the growing, storage

and utilization of fruit and fruit products are investigated, and the Campden Research Station, Gloucestershire, where the commercial preservation of fruit and vegetables is studied.

Finally, during the past four or five years a powerful and effective weapon has been placed in the hands of the Agricultural Adviser—the microphone. By means of talks, debates and discussions, such as those given in the West of England Programme of the B.B.C. once a week, in which farmers, young farmers, agricultural workers, Advisory and Research Officers and members of the consuming public take part, farmers young and old, and others interested in the land, can hear and learn "over the air" the latest information on farming matters. It has been possible, by means of the microphone, to make farming contacts over a very wide area, both at home and abroad, and the dissemination of agricultural knowledge to those who care to listen is readily and speedily achieved. Advance programmes of farming talks are given on p. 1178 of this JOURNAL.

In conclusion, I should like to acknowledge my indebtedness to my colleague, Dr. C. V. Dawe, Advisory Economist at the University of Bristol, for the statistical information he has provided for this article.

GRASS AND CROP DRYING ON A YORKSHIRE MIXED FARM

CLIFFORD BOWLES

A Kilmartin Grass and Crop Dryer was installed at the Home Farm on the Swinton Grange Estate, near Malton, Yorkshire, owned by The Honourable Mrs. Clive Behrens, in the late spring of 1937. At this time, grass drying was definitely emerging from the experimental stage and various types of machines were on the market. To meet all circumstances on a large, mixed farm, it was recognized that, if full use was to be made of the large capital expenditure involved, the plant must be capable not only of drying grass at all stages of growth, but heavy leguminous crops, such as sainfoin or lucerne and, if the need arose, corn crops also. In fact, it was necessary that the dryer should fulfill the following conditions: serve as a complete insurance against wet weather conditions; give an output of dried material large enough to obtain economic production costs; be simple in design to ensure low repair bills; and, finally, be easily manageable by unskilled farm labour. Eventually, I decided that the Kilmartin plant most nearly met my requirements. The dryer was invented by the late Charles Tinker, of Inverness, as a result of grass- and crop-drying experiments extending over more than 15 years in one of the wettest districts of Scotland.

The Swinton Grange Farm comprises 700 acres—400 acres of permanent grass and 300 acres of arable land—medium heavy, and naturally drained on a limestone subsoil. A fairly large head of stock is maintained, viz., over 100 head of attested Ayrshire cattle, 700 ewes and followers, 40 sows, 35 thoroughbreds and hunters and 1,000 head of poultry. The concentrated feeding-stuffs bill for this number of stock is naturally very heavy during the winter months, but, to reduce the expense, as much grain and fodder as possible is home-grown. It was expected that the use of dried grass in rations for the live stock would still further reduce the outlay on purchased foods, and this has proved to be the case. The grass has been used chiefly for dairy cows, young stock and horses, the sheep only having a small allowance just before and after lambing. The dairy cows are kept, as far as practicable in this rather cold district, on an open-air system,

running out on the pastures all the year round during the day and housed during the winter at night in large, open folds and loose boxes. The young stock are also housed during winter nights in large, covered yards. One-third of the ewes lamb down in January and the rest in March and April, the object being to sell off between 400 and 500 fat lambs before the end of August. Turnips and swedes are grown for winter and early spring folding and also marrow stem kale for the cattle. The sheep have proved most useful in the management of pastures for grass drying. By careful grazing and fertilizing it has been possible to control the grass and bring it to the right stage for cutting without having recourse to making hay from fields grown beyond the "dried grass" or "super-hay" stage.

Description of Plant. The Kilmartin plant was built into an existing Dutch Barn and comprises:—

(*a*) One 13 ft. by 5 ft. Morris Vertical boiler with three cross tubes, having an output of 1,425 lb. of steam per hour at 100 lb. pressure —burning coal, small steam nuts.

(*b*) The drying unit supported by eight steel girders consisting of a series of six steam coils mounted as a truncated cone 11 ft. high with a 10 ft. 4 in. diameter base and 5 ft. 8 in. diameter apex. The cone is further extended another 4 ft. with a galvanized-iron cowl, the inside top of which is domed. The drying coil is placed directly over the air duct vent and the steam in each coil section is controlled by six valves grouped at a header near the boiler outlet.

(*c*) A 2 ft. 6 in diameter forced draught Keith Blackman fan, driven by a 25 h.p. Brook electric motor at 700 revolutions per minute giving an air output of 27,000 cu. ft. per minute.

(*d*) A steam trap and Weir boiler pump.

(*e*) A small preheating economizer coil situated in the air duct, and a water supply tank for the boiler. The Dutch Barn has a concrete floor with covered-in sides and there is a separate brick-built boiler house adjacent.

Operation of Plant. The drying medium is steam-heated air driven by the fan at the rate of 27,000 cu. ft. per minute through an underground air duct opening out into the centre base of the cone. The air is driven to the dome situated inside the top of the cowl and from there forced out through the coils and surrounding wet grass or corn. Steam from the boiler is passed through the coils at the rate of 1,425 lb. per hour, creating a temperature of about 300°F. The waste steam and condensate is led back from the coils over check valves to a steam trap in the boiler house, and from this point

FIG. 1.—Packing the Dryer

Photograph by courtesy of "Farmer and Stockbreeder"

FIG. 2.—Finishing off the packing

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driven into the boiler supply tank *via* the economizer coil in the air duct. This economizer raises the temperature of the air before it enters the cone by about 5°F. The water in the supply tank, heated by the waste condensate, is pumped back into the boiler by the Weir pump at a temperature of approximately 180°F. The time taken for drying varies considerably according to the water ratio and nature of the crop dealt with. Generally speaking, short young grass from 5 to 10 in. long dries in 16 hours, sainfoin from about 12 to 16 in. long takes 12 to 14 hours, and corn crops in the sheaf from 7 to 8 hours.

Output. The output of the dryer also varies considerably and is governed by the factors mentioned above. The 1938 drying season has resulted in a total output of 227 tons of dried grass and super-hay in 55 working days, an average daily output of just over 4 tons. The maximum output in any one day was 5 tons 11 cwt. This total output was obtained from 254 acres of grass and 3 acres of sainfoin; 50 acres of grass and the 3 acres of sainfoin were cut twice, the rest once, so that the one cut equivalent is 310 acres, giving an average production of nearly ¾ ton per acre. The above acreage of grass dealt with includes about 100 acres dried for neighbours, which was cut once only. The crude protein analysis of the 227 tons of grass and sainfoin dried this season gives varying figures, but approximate results showed that 25 per cent. of the total output had a protein content of from 16 to 20 per cent.; 50 per cent. from 12 to 16 per cent. protein, and 25 per cent. from 9 to 12 per cent. protein in the dry matter. The carotene contents varied from 250 m.g. to 400 m.g.

Method of Working. The general aim is to use the grass dryer as an integral part of the farm organization. No extra labour is employed. No expert mechanical knowledge is necessary to manage the plant; only one man has charge of the plant during the drying operation and his work merely consists of stoking the boiler and arranging the supporting pegs round the stack as drying proceeds. About 14-17 tons of green, freshly-cut grass is placed in a circular stack, about 18-20 ft. diameter round the drying-coil. The stack has almost vertical sides, slightly sloping in towards the apex and completely covers the coil when finished. To prevent rapid

settlement, wooden battens intersected with iron pins 15 in. long are placed round the outside of the stack. These iron pins are driven into the grass and removed as drying progresses.

The grass is cut with either a horse or tractor twin cutting-bar mower, and is raked into windrows. It is collected by farm waggons and a motor lorry and carried to the drying-shed. A motor-driven elevator is used to raise the grass to the flat top of the coil, upon which a man stands to receive it, and this man throws the grass down to two men stacking round the coil below. The stack must be made with care and the grass well shaken to ensure even drying. The complete operation of making the stack, including the necessary field work, usually takes 8 or 9 men from 5 to 6 hours. The number of men necessary and the time taken for making the stack depends entirely upon the distance of the field from the dryer. The grass is not wilted, but part of it has occasionally been cut the evening before drying to ensure a good start with loading on the following day. One man is left in charge of the plant when the stack is completed. This man is relieved at 8 o'clock in the evening by another who stays through the night until the stack is dry. At 7 A.M. the following morning the grass at the top of the stack round the galvanized-iron cowl, which is not completely dried, is placed on one side for inclusion in the next stack made. It is an essential part of the process that the grass on the stack top should remain half dried at the finish so that the extra weight at the top may keep the stack consolidated. The dried grass is then removed by the gang of 8 or 9 men in about 2½ hours and stored in a Dutch barn. None of the grass is baled, as it is used wholely for home consumption. In this way five stacks of dried grass per week are made, a total of about 20-25 tons.

Drying Corn. Drying corn in the sheaf is a very simple process with this dryer. The sheaves are carted to the dryer and placed at a tangent to the coils. No supporting battens or iron pegs are necessary and a much larger stack can be made than when drying grass. During the very wet harvest of 1938 good use was made of the dryer, and 30 acres of oats and 12 acres of barley were dried in 7 stacks. The oats, when threshed, yielded 10 quarters per acre and dried in from 7 to 8 hours. The barley dried in 10 hours, taking longer than the

oats as the under-sown clover crop was about 14 in. long. The corn crops when dry are either threshed straight from the dryer or stacked in a Dutch barn. The acreage of corn dealt with at one drying could be easily increased to 8 or 9 acres if the drying-shed were larger.

Costs. In 1937, the Department of Agriculture of Leeds University kindly consented to cost the dryer, and the results of their work provided some very interesting figures. The dryer worked for 44 days and dried 160 tons of grass. The short working period was due to a delay in installing the plant, and the serious drought during the months of July, August and September. The average costs of production per ton of dried grass and super-hay were as follows:—

	£	s.	d.
Rent	0	6	7
Cultivations	0	0	4
Fertilizers, including spreading	0	1	5
Grassland overheads	0	0	10
Man labour	0	13	6
Horse labour	0	4	0
Fuel	0	11	3
Power	0	5	1
Depreciation	1	1	3
Insurance	0	1	3
Total	£3	5	6

In connexion with these costs it is recognized that the figure for fertilizers is low and in all probability will be higher in future. It should be noted, however, that the depreciation cost of £1 1*s*. 3*d*. is based upon a 20 per cent. charge, which, in my opinion, is too high for this type of plant. There are only three moving parts, the fan, fan motor, and boiler pump, and the dryer is constructed to give a life of at least 25 years. Labour and fuel costs are comparatively low, and I think the reason for this is simplicity of design and the bulk method of working. The capital cost of the plant when installed, including an allowance for shed and boiler house, was £1,000.

A very severe drought lasting about three months preceded drying operations in 1938 and incidentally reduced total output, as drying could not be started until May 25. No complete costing has been kept during the 1938 season, but available data suggest a figure of approximately £3 per ton. A few slight alterations to the plant were made in the winter of 1937-38, and these have resulted in an increase in output of

nearly half a ton per day. Such an increase should reduce production costs slightly. From my own observations during this season, the following fuel and power costs confirm the 1937 costs kept by Leeds University:—

Coal used for producing 227 tons of dried grass—98 tons at 30*s*. per ton	£147 0 0
Electric power used—14,607 units at ¾*d*. per unit	£45 12 8

This gives a fuel and power cost of 17*s*. per ton of dried grass in 1938 as compared with 16*s*. 4*d*. per ton in 1937.

Starting on June 28, 1938, the dryer was carefully tested over a 4-day period by three impartial grass-drying and engineering experts. The grass dealt with was the second cut from a one-year ley, chiefly Italian ryegrass and English red clover. The first cut from this field was dried on May 25 and 26. Their findings were as follows:—

Wet grass brought to dryer	45·20 tons
Grass from stack top dried on following days	3·35 ,,
Dried grass produced	17·96 ,,
Water evaporated	23·89 ,,
Coal used in furnace	97 cwt.
Electricity consumed	1,044 units

It will be noted from the above figures that the daily output of dried grass was nearly 4½ tons, and that the initial material had a relatively low water content of something under 60 per cent. The coal costs amounted to 8*s*. per ton of dried grass, with coal costing £1 10*s*. per ton, and electricity, at ¾*d*. per unit, to 3*s*. 8*d*., a total fuel and power cost of 11*s*. 8*d*. per ton.

Results of Feeding. Experience of feeding dried grass to all classes of stock at Swinton Grange has convinced me of its palatability and good feeding qualities. Results have been particularly striking in respect of milk production:—

Year 1936–7 *No* dried grass fed. Average yield of milk for 30 full-time cows ..	7,033 lb.
Year 1937–8. Dried grass fed. Average yield of milk for 38 full-time cows ..	9,320 lb.

While it would be dangerous to assert that the feeding of dried grass was the only cause of the substantial improvement in milk yields in 1937-38, I am certain that it played an important part. In addition, the cows kept in excellent condition, finishing in full bloom in the late spring after three months of serious drought. The ration consisted of 7 lb. of

good quality dried grass for the first gallon of milk and part maintenance, a mixed ration of 3½ lb. of cake and meals per gallon for all milk over the first gallon, and the requisite amount of dry matter was made up with medium quality sun-made seeds hay with marrow stem kale or mangolds when available. More dried grass would have been fed if a greater quantity had been dried, but supplies were limited owing to the short drying season. The calves, young stock and sheep did equally well. When fed to hunters and blood horses, the grass, when placed in the mangers with corn, was invariably cleaned up first. The average corn ration for the horses was reduced by one bushel per week when dried grass was fed.

In my opinion, the value of dried grass as a feeding stuff lies not only in its protein content and palatability, but also in its vitamin and mineral constituents which are conducive to good health in the animal. In dried grass these constituents are assimilated in a natural form, chemically balanced by nature herself. Modern production tendencies, such as high milk yields, early maturing of lambs, baby beef, and large egg production can only result in one thing if persisted in without due regard to adequate compensation for the drain made upon the animal, and that is loss of constitution, disease and breeding troubles. The ill effects of forcing the animal to unnatural limits of production can be counteracted to a certain point by artificial feeding, but, if persisted in, the reserves which the animal draws upon from its own body must be replaced. Evidence of this has already shown itself with poultry, and to a lesser extent amongst pigs. I believe the solution lies in feeding a certain amount of dried grass and other green fodder crops which contain the essential vitamins and mineral matter required during the winter months when sunshine is limited and the animal has least resistance. These considerations justify the trouble of artificial drying, providing the process can be carried out economically.

The Kilmartin plant has more than justified its installation on this Estate and has fulfilled all that was required of it as regards the provision of a first-class feeding stuff at low cost. A great improvement in the pastures has also resulted by mowing more frequently at a time of the year when the grass grows more quickly than it can be consumed by live stock. The plant is simple in design and thus "fool-proof," repairs are negligible and it can be managed by unskilled farm labour. Dried grass production costs are low and almost any fodder

or corn crop can be dried. In addition, it has proved a valuable insurance against wet weather conditions. An enormous sum must be lost annually in this country as represented by protein, minerals, etc., by making hay naturally, besides the loss in animal health and productivity as a result of inferior fodder. Drying small quantities of high-protein grass for limited periods during the season with an expensive plant is not likely to attract much enthusiasm from the majority of farmers. This class of drying is more for plants run on factory lines. Whether the hay-making season be fine or otherwise, I visualize the future of grass drying for the farming community as essentially bound up with a machine which will not only deal with the small amount of short, high-protein grass available, but the hay crop cut in the young stage also. To be an economic process the output must be large, so that the farmer can dry *all* his grass at an inclusive cost of less than £4 per ton. The Kilmartin plant which I have described will easily deal with as much as 300 to 400 acres of grass in a normal season, but I understand that increased attention is being given to the construction of a plant two-thirds the size of this one, suitable for smaller acreages. Where electric power or an oil engine is not available, the fan can be driven by a steam engine fed direct from the boiler. From experience gained here, future installations will have a higher boiler-efficiency, and better use will be made of the waste condensate from the drying-coils by means of an improved type of air pre-heater. This will undoubtedly reduce drying time and probably further increase the daily output.

MANURING FOR POTATOES

F. Hanley,
School of Agriculture, Cambridge

Farmyard manure is undoubtedly the best general basis for the manuring of the potato crop, which not only repays liberal manuring but appears to be particularly responsive to dung. Direct experimental evidence on the value of dung for the potato crop in recent years is provided in the Rothamsted Report for 1937, where it is shown that in each of 11 experiments an increase in yield was obtained from the use of dung. The increases ranged from 1.1 to 5.0 tons per acre. This evidence is in agreement with the findings of earlier experiments, such as those carried out in Ireland during the early years of this century when, on the average of a very large number of trials, a dressing of 15 tons of dung per acre raised the total yield of tubers from only 4.0 tons per acre to 8.2 tons per acre. Again, experiments at 37 centres in North Wales during the period 1892 to 1925 showed an average increase in yield of 4.05 tons per acre from applications varying from 10 to 15 tons of dung per acre on land receiving no artificials. This represented a 74 per cent. increase in crop, the yield without dung being only 5.5 tons per acre. On the other hand, good crops of potatoes are sometimes produced without farmyard manure, particularly on land rich in organic matter. For instance, in other experiments in North Wales, on land with a good content of organic matter, 8 cwt. per acre of a mixture of superphosphate, sulphate of ammonia and sulphate of potash, gave 9.35 tons per acre of potatoes as compared with 9.65 tons from a moderate dressing of dung. At Wye also, satisfactory crops are said to have been obtained with artificials alone, sometimes, on land previously well supplied with humus. Nevertheless, on potato-growing farms on all types of soil the potato crop affords probably one of the best opportunities for utilizing dung and, on land lacking in humus, dung is the most important manurial requirement of the crop.

As will be mentioned later, farmyard manure not only produces a marked effect on total yield, but frequently has a beneficial effect on the proportion of tubers of ware size, especially on land where yields are generally low.

As regards the most economical dressing of dung, Welsh

experiments showed that a further 10 tons of dung over and above a basal dressing of 10-12 tons per acre, increased the yield by more than 20 per cent. at 8 out of 28 centres, but on the average of all centres it failed to produce a significant increase. Increasing the dressing of dung from 12 to 18 tons per acre at Wye, and from 15 to 20 tons per acre in Ireland, resulted in an increase of just under 1 ton per acre in the yield of potatoes. It seems, therefore, that a moderate dressing of dung (10-15 tons per acre) is usually well worth while, but, though a heavier dressing will often give a further small increase and may more than pay for itself under some conditions, in general, the extra quantity could probably be utilized to greater advantage on some other part of the farm.

Very heavy applications of dung are not usually justified by comparison with moderate dressings, and 10 to 15 tons per acre, supplemented by suitable artificials, should be adequate in most circumstances.

There is little reliable experimental evidence as to the relative merits of different methods of applying dung for the potato crop. The two most common methods, viz., in the bouts or drills immediately before planting, and spread on the land prior to deep ploughing, each have their own advantages and disadvantages. Such points as the general organization of the work of the farm to reduce the demand for labour during the busy spring months will always influence the choice of the method of application to be adopted on most farms, but it is interesting to note that experiments at Rothamsted in each of the three years 1935, 1936 and 1937 revealed a definite advantage from application of dung in the bouts or drills over dung ploughed in during December or January. The dung in these experiments was applied at the rate of 15 tons per acre and gave an average yield increase of only 1.5 tons per acre when ploughed in as against 3.1 tons per acre increase when applied in the drills. In other words, dung applied in the drills gave a definitely better result than dung ploughed in, the difference varying from 0.91 to 2.96 tons per acre. Confirmation of this result over a wider range of soil and climatic conditions seems very desirable, for a difference of this magnitude is certainly worthy of full investigation.

But farmyard manure alone does not supply the right amounts of the various plant foods required by the potato crop and the use of fertilizers to supplement the dung has been the subject of much experimental work. At Wye, the

addition of 7 cwt. of fertilizer to a basal dressing of 12 tons of dung gave an increase in the yield of potatoes of 1.67 tons per acre as compared with the yield from plots receiving dung alone. In North Wales, dung plus 8 cwt. of artificials gave 2.1 tons per acre more potatoes than dung alone—an increase of nearly 25 per cent. In two series of trials at the Midland Agricultural College the addition of approximately 8 cwt. per acre of artificials to plots receiving a basal dressing of 12 tons per acre of dung, gave average yield increases of approximately 3 tons per acre in one series and 4 tons per acre in the other series, over plots receiving dung but no artificials.

Sometimes the results of experiments have challenged existing practice in regard to the manurial treatment of the crop. For instance, Wallace at Kirton showed that, in some circumstances, the importance of phosphate could be easily over emphasized, for he found that, on some of the Lincolnshire silt soils, the amounts of phosphate commonly used could be reduced considerably without loss of crop. The results on these silt soils were probably due in part, at any rate, to their past treatment, which included heavy applications of fertilizers with a high phosphate content, and Wallace's discovery has led to the use of fertilizer mixtures with a lower phosphate content and higher content of potash in these silt-land areas. But the general importance of phosphate to the potato crop should not be unduly minimized as a result of these silt-land trials—the more logical and practical conclusion is obviously that its importance varies with soil type and with past treatment. On black fen soils in particular the value of a good dressing of phosphate is indisputable. The importance of potash is now generally accepted, and though it is more essential to main crops than to earlies, a moderate amount should be included in the dressing for early varieties, especially as they are usually grown on the lighter types of soil that are likely to be low in potash. Potash is also more important on the lighter types of black fen, especially those overlying gravelly or silty deposits, than on medium fen soils overlying clay.

Nitrogen has usually a marked influence on yield. In a summary of the results of a large number of trials a few years ago, E. M. Crowther showed that in 90 per cent. or more of the trials, including several on fen soils, there was a definite response to nitrogen in the form of sulphate of ammonia,

though it is not long since nitrogen in any form was considered unnecessary for the potato crop on black fen. On black fen soils with their large natural store of nitrogen, mineral fertilizers are admittedly the first necessity, and even to-day many fenland farmers do not include nitrogen in their potato fertilizers. Nevertheless, there is now ample experimental evidence proving the value of a moderate dose of sulphate of ammonia on black fen soils provided liberal applications of phosphate and potash, especially phosphate, are also given. To use nitrogen alone is wrong on any type of soil and is particularly unwise on fen soils, but where dressings of 10 to 15 cwt. per acre of artificials are to be used they should contain nitrogen, even on black fen, where about 4½-5 per cent. nitrogen in the case of compound fertilizers, or about 2 cwt. per acre of sulphate of ammonia in a "straight" mixture would be a suitable amount in conjunction with phosphate and potash.

The interaction between nitrogen, phosphate and potash is often clearly marked in the potato crop, response to one being dependant on adequate supplies of the others. The dressing of artificials should be increased in the absence of farmyard manure, potash in particular becoming relatively more important when dung cannot be given. This connexion between the effects of dung and potash is well illustrated by a study of the effects of manurial treatment on the proportion of ware. Manuring has little effect on proportion of ware-size tubers when the percentage is already high (80 per cent. or over) but when the percentage ware without manure is low, then manures can bring about a considerable improvement in this respect. A detailed account of this aspect of the problem appeared in earlier issues of this JOURNAL* and a report by H. V. Garner in the *Empire Journal of Experimental Agriculture* for October, 1937, showed that, on the average of a large number of experiments, dung raised the percentage of ware-size tubers by 15.3, potash by 7.6, phosphate by 2.1 and nitrogen by 2.0 per cent.

The quantity and composition of the fertilizer mixture for potatoes must obviously vary with circumstances but, when a moderate dressing of dung is available, up to 15 cwt. per acre of a suitable mixture of artificials can often be used profitably on good soils capable of giving a high yield, e.g., silts and fens;

* March, 1937, and March, 1938.

but on poorer soils it is rarely economic to use such heavy dressings and 8-10 cwt. per acre is a more suitable application. In the absence of farmyard manure the dressings can be increased slightly, but it is not usually profitable to attempt to force the yield on the poorer types of soil by giving very heavy dressings of artificials.

Experiments on methods of applying the fertilizer for the potato crop have not yet reached the stage at which definite conclusions can be safely drawn. Trials in America suggest very definite advantages from placing the fertilizer at a slightly lower level in the soil than the potato "sett." Bates, in trials on West Norfolk silt and fen soils, obtained better yields from fertilizer sown along the bottom of the ridge and lightly scuffled into the soil than from fertilizer broadcast with a distributor over the ridges before splitting, but he emphasized that the trials were carried out in a district of low rainfall and suggested that differences might be less marked where the rainfall is higher.

It is common practice nowadays to think not only in terms of yield per acre but also in terms of quality. Quality, however, is not an easy thing to define and with potatoes may vary according to the method of cooking, e.g., frying or steaming. The few scientific investigations carried out in this country into the effect of manuring on quality of potatoes support the view that potassic fertilizers tend to improve quality, at any rate for steaming. It is also usually held that sulphate of potash is better than the lower grade potash fertilizers and to a smaller extent than muriate of potash. But, in general, where moderate dressings of fertilizers of reasonable analysis are used, the effect of fertilizer treatment on quality of tubers is small by comparison with the effect of differences in soil and climatic conditions.

The introduction of regulations governing the size of riddle to be used in preparing potatoes for market has focussed attention on the question of size of tubers—especially since over-size tubers have, on occasion, suffered the same fate as their under-sized brethren. It was shown in an earlier paragraph that manuring, particularly with farmyard manure and potassic fertilizers, will, in certain circumstances, increase the proportion of ware-size tubers and in this designation of "ware" no upper limit was imposed. It should perhaps be emphasized here, however, that the effect of manuring on the proportion of ware-size tubers is only marked when the

initial proportion is abnormally low, and though the proportion of small tubers may sometimes be reduced by suitable manuring, any attempt to control the proportion of over-size tubers by reduced manuring is more likely to result in a general reduction in yield rather than a mere " slimming " of large tubers. With the exception mentioned above, control of tuber size is more likely to be obtained by a consideration of the size of seed, the cutting of large setts and the spacing between setts, on the lines of such trials as those carried out by the Norfolk County Council and by the National Institute of Agricultural Botany.

THE COST OF HORSE LABOUR

A. J. Marval

AND

P. J. Jones,

The Lord Wandsworth College

As an introduction to the cost figures that follow, a short description of the College farm and the system of farming employed is desirable. For the greater part of the period to which these figures refer, April 1, 1930, to March 31, 1937, the area under crops and grass amounted to about 750 acres, of which approximately half was under permanent grass. The main set of farm buildings, which includes the stabling, is centrally placed, while the more remote corners of the farm have been made reasonably accessible by means of metalled roads. The average area of all fields is 16 acres, with a maximum of 36 acres, and the number of small, arable fields is few.

In pastures grazed by the milking herd, automatic main-water supply is generally to be found, while both pig and poultry units also have their own main supply. Water carting is therefore restricted to the needs of cattle in outlying pastures, of the sheep in spring and summer, and of the rick thatcher.

The soil varies widely in texture and fertility. At best it is a fairly heavy, flinty loam overlying chalk at a depth of ten feet or more, while in places it is a shallow chalk rubble, hardly worth cultivating under present conditions. The greater part of the cultivated acreage on this farm consists of a moderately heavy flinty loam that would be considered relatively light and poor, judged by clay land corn-farming standards, but which has the advantage of being naturally drained. In consequence, it will carry horses quite soon after really wet weather and it is thus possible to maintain a high number of annual working hours.

The system of cropping is based on a three course of two white-straw crops, followed by a cleaning or restorative crop,

except where the comparative poverty of the soil demands a lengthening of the rotation. Approximately one-third of the arable area is in wheat, one-third in spring corn (chiefly oats), with the remaining third chiefly of temporary grass, with quite small areas of fallow, mangolds, and root crops for sheep folding. The bulk of the farm's hay requirement is obtained from this temporary grass, and the lattermath may supply grazing for the fattening lambs or a crop of seed. The leys generally consist of Common or Giant Sainfoin, though mixtures containing Broad Red Clover, Lucerne, Alsike, and Perennial Ryegrass may also be used. Such a rotation tends to produce peak horse-work periods in the early autumn, the spring, June, and August.

The permanent grass is only moderately productive. A " flush " rarely occurs before May, and it commonly dries up badly by July. In an abundant year, a proportion of the pasture acreage may be mown, but the relatively light crops rarely require much making.

The climate can be summarized thus. From late August to the beginning of March is generally a very wet period, for during this time the normal total rainfall amounts to 18.5 in. —nearly an entire year's allowance in certain parts of East Anglia. Severe weather is often experienced and frost may be expected from the beginning of October until the end of April. The farm lies between 400 and 550 ft. above sea level with a general northerly aspect; as a result, once the soil has become wet in the autumn it does not begin to dry at all rapidly until March, and sometimes later. The general effect of such a climate upon farm operations is to produce two peak work-periods in the autumn and spring, the first lasting until most of the drilling has been completed (usually by the end of October), the second commencing in March. All spring corn must then be sown, winter corn harrowed and rolled, top-dressings applied, grass land cultivated, and temporary leys sown. Root crops are drilled after the more pressing spring work has been completed, generally about the end of April. In the autumn, to avoid early frost and to expedite the work under the most favourable conditions, mangolds are lifted and clamped early in October. During the winter months, root and fodder carting to cattle and sheep forms a routine job.

The summer period is generally cool and of brief duration. Hay-making starts early in June, a late spring preventing

earlier mowing, and corn generally ripens by the beginning of August. Owing to the prevalence of heavy dew, little can be done with the hay crop before midday and, for the same reason, some delay may be occasioned in the harvest field. Available man and horse labour has therefore to be carefully organized so as to complete the work in the shortest time. The serious drying up of the pasture in early June is also usually an unfortunate characteristic of the season, entailing the carting of much fodder, roots, and water to live stock.

All the horses are Shires of a rather light, active type strong enough for hard work on fairly heavy, wet land. During the period 1930-37 their average age varied from year to year from 10½ to 12½ years, and the number kept, in conjunction with one tractor, fell from 13 to 11. Rations are normally distributed to the carters once a week, the actual daily allowance to individual animals being left to their discretion. For convenience, horses are always shod on the farm, either after work, in the stables, or, during rush periods, in the fields.

In the ordinary way an 8-hour day, commencing at 7 a.m. and finishing at 3.30 p.m. is worked, with a half-hour break and a nosebag in the field at 11.30 a.m. The horses lie out during the summer months, though for much of the time reviewed in this article they did so also in the winter. Each carter attends to his own pair of horses, though in a district where 3-horse teams are frequently seen, the practice is not a general one.

The Cost of Horse Labour. In arriving at the cost of horse labour on a farm, the following charges have to be considered:—

(*a*) Food.
(*b*) Labour in attendance on the horses.
(*c*) Depreciation in the value of the horses.
(*d*) Depreciation on harness and stable equipment, together with repair charges incurred in their maintenance.
(*e*) Shoeing charges.
(*f*) Veterinary fees.

The last three of these items are relatively unimportant for, as the following Table shows, they form only 13½ per cent. of the total cost. At the same time it must be realized that, under conditions of inferior management, they might assume far greater importance.

TABLE I.—THE AVERAGE ANNUAL MAINTENANCE COST OF A HORSE ON THE COLLEGE FARM

Item of Cost	*Total Charge* £ s. d.	£ s. d.	*Percentage of Total Cost*
Food:			
Oats	13 6 6		
Hay	3 14 1½		
Flaked maize	0 3 8		
Grazing	2 1 7		
Total		19 5 10½	57
Attendance on horses		6 2 5	18
Depreciation on horses		3 18 3	11½
Harness depreciation and repairs		1 11 10	5
Shoeing charges		2 12 10	8
Veterinary fees		0 3 4½	½
TOTAL		£33 14 7	100

Considering individual items in greater detail:—

FOOD. Easily the most important single charge on the horses. On the College farm, home-grown foods are fed almost entirely, in fact, the only purchased food fed during the period was 2½ tons of flaked maize, which replaced part of the grain ration when oats had risen sharply in value.

The average oat consumption per horse per annum amounted to 26½ sacks, or almost 2 tons, but the range of variation from year to year was wide, being affected both by the market value of oats and by the extent to which the farm's horse labour was employed on really heavy work during the year. Formerly "Grey Winters" were used, but their comparatively low yield, and habit of seriously lodging in the field, caused them to give way almost entirely to spring-sown "Victory" oats, though admittedly the latter possess a lower feeding value. Oats were charged at market price—over the entire septennial period an average figure of £1 0s. 9*d*. per quarter.

The average tonnage of hay eaten annually by a horse amounted to 1.33 tons, though with this also the range of variation from one year to another was wide, namely, 0.61-1.9 tons. Generally speaking, the hay requirement has fallen since 1933-34, no doubt due largely to the short crops gathered in the successive drought years of 1933 and 1934, which necessitated restricted feeding. The relative abundance of winter grazing in the past few years has made this much easier to accomplish. Hay from Sainfoin or mixture leys is usually fed and is always trussed. It is charged to the horse account at market price, including 3*s*. 6*d*. per ton for trussing,

and over the entire 7-year period averaged £2 16*s*. 6*d*. per ton with a range of £2-£3 17*s*. 3*d*. per ton.

The annual charge per horse for grazing fluctuates widely between £1 and £3 6*s*. 0*d*., with an average of just over £2. It is charged at cost of production, including such important items as rent, cultivation charges, and manuring.

LABOUR IN ATTENDANCE. This important item includes wages paid for overtime work in attending the horses, as well as for other services, such as the carting of hay and straw to the stables.

DEPRECIATION ON THE HORSES. This charge was calculated in the following way. To the initial valuation in April, 1930, was added the price of all purchases delivered to the farm. From this total the sum of all horse sales, less market expenses, and the final valuation figure in March, 1937, is deducted. The method adopted may be summarized thus:—

	£ s. d.	£ s. d.
Valuation, April 1, 1930:		
14 horses	358 0 0	
5 „ purchased	244 17 0	
		602 17 0
8 horses sold	81 15 0	
Valuation, March 31, 1937:		
11 horses	210 0 0	
		291 15 0
Difference, being a Depreciation		311 2 0
Average total annual depreciation on the Farm's Horse stock		44 9 0

The average purchase price of all horses bought during this septennial period was almost £49, fluctuating narrowly between £45 and £52 10*s*. 0*d*. The 8 animals sold at an average of £10, but this figure actually is misleading, for two of the animals fetched £36 and £27 respectively.

DEPRECIATION ON HARNESS AND REPAIR CHARGES. On this farm it is usual to give all harness a thorough overhaul once a year, and also by ensuring close attention to its upkeep during the year, when the weather renders outside work impossible, it has been possible to keep this item of cost within reasonable limits. The cost of minor purchases, such as dandy brushes and curry combs, is included.

SHOEING CHARGES. This charge shows little variation from year to year. The frequency of renewal and attention is found to vary greatly among individual horses, but it can be generally said that, owing to the flinty character of the soil, wear and tear is probably relatively heavy.

VETERINARY CHARGES. The horse doctor is an infrequent visitor to the farm as the charge in Table I (p. 1110) shows.

An Analysis of Horse Work on the College Farm. The number of hours worked by a horse on the College farm during a year varied between 1,300 and 1,800 hours, with an average of 1,562 hours, or nearly 200 days. The busiest months are October and March (or possibly, in wet springs, April), while relatively slack periods are May and the winter period from the end of November to the end of February.

The farm horses as a whole average just over 19,000 hours of work annually. The manner in which this working time is occupied is shown in the following Table:—

Type of Work	*Average Annual Total*	*Percentage of the Total Hours Worked*
	Hours	
Ploughing	5,715	29½
Attendance on Live Stock	2,209	11½
Harrowing	1,698	9
Corn Harvest	1,465	7½
Hay Harvest	1,387	7
Carting F.Y.M.	1,336	7
Drilling	1,004	5
Establishment Work	738	4
Dragging and Cultivating	641	3½
Rolling	634	3½
	16,827	87½

The more important of the miscellaneous items of work which make up the remaining 12½ per cent. of the working time are artificial manure sowing, root crop cultivation, lifting and clamping of root crops, attendance at the threshing drum, the carting of chalk and estate work generally.

Nearly one-third of the total time worked by the horses is spent ploughing, and fully 75 per cent. of this is done in the autumn. Although double-furrow ploughs pulled by a team of three horses are a common sight in the district, on the College farm the single furrow plough with a 2-horse team is preferred. Much use is made of the furrow land-press, with or without the seed-box attachment, in conjunction with the plough, when at work on ley ground or for the later autumn corn drilling on land which has become rather sticky.

Attendance on live stock occupies a large proportion of the horse's time, particularly for the dairy herd of 45 milking

cows and young stock and to a lesser degree for the breeding flock of 250 Halfbred ewes. Normally, the dairy herd demands about 1,200 hours of the horses' time, though of course in dry seasons or severe winters the requirement may rise considerably above this figure. Similarly, the sheep flock's requirement also fluctuates widely according to the season, though generally it is in the neighbourhood of 650 hours. Pig and poultry units make little demand on the horse labour.

Harrowing is the next most important item of horse work. Three-quarters of the total time spent in this way is on the arable land, grass land only receiving attention when the demands of the former have been met.

The number of hours spent in hay-making varies greatly from year to year, being largely dependent upon the type of weather experienced in spring and early summer. Thus, in 1933, a year of drought, when a smaller area than usual was mown and crops themselves were light and easily " made," only 688 hours were worked in this way by the horses. On the other hand, in 1931, a wet year, grass was abundant, so that a larger area was therefore mown, crops also were heavier and their gathering less straightforward. On that occasion the horses put in 1,900 hours hay-making. Second cuts of hay are rather infrequently taken.

In view of the considerable head of stock carried, the volume of dung made and applied to the land is relatively small. This is largely explained by the fact that the dairy cattle lie out both winter and summer, as did the horses for much of the period under review. Again, litter is used in the pig pens only during severe or very wet weather. Taking an average figure, the same number of hours are worked in this way as in hay-making and fluctuations from year to year are similarly wide. The work is usually carried out during very wet or frosty weather in the winter, or after corn harvest. It is no surprise to find more dung-carting carried out during the wet winters of 1930-31, 1935-36 and 1936-37.

Under the heading of Establishment Work is included work done for the benefit of the farm as a whole, such as the carting of timber from the woods for fencing, stack bottoms, or hurdles, the tidying up of stack-yards, building up field gateways and the area around water-troughs, and the disposal of cavings after threshing. Much of this general utility work is done during the winter months, when land work is difficult

or impossible, and naturally increases in unusually wet or cold seasons.

Time spent Dragging and Cultivating is mainly on the fallows and showed a marked increase in 1930-31 and again in 1933-34, when unusually dry summers were experienced.

Summary. 1. The cost of maintaining a working horse on the College farm amounts to, in round figures, £34 per annum. Three items, Food, Labour in attendance, and Depreciation on the horses together total all but £4 of this sum. Food alone constitutes over half the total cost, and the importance of cheap supplies of corn, hay, and grazing, allied with a system of economical feeding, if the cost per working hour is to be low, needs hardly to be emphasized.

2. During the period reviewed the average number of hours worked by a horse in a year amounted to 1,562 hours. Nearly one-third of this time was spent ploughing.

3. The average hourly cost of horse work amounted to 5¼*d*.

FUSARIUM DISEASE OF CEREALS

F. T. Bennett,
Advisory Mycologist, King's College, University of Durham

The mention of Fusarium disease in cereal crops would have aroused little or no interest amongst farmers a few years ago, for the reason that very little was known of such trouble and therefore its importance in farming economy was not realized. Now with more knowledge about the cause and progress of the disease, its effects were more generally realized during 1938 when the seasonal weather favoured its greater prevalence. Some years ago, field observations directed by Professor Brooks in the Cambridge area indicated that the yield of corn in general would probably be from 20 to 25 per cent. greater if there were no Fusarium disease. Whilst we have no reasonably reliable method of estimating the total losses throughout the country, it may be assumed, in view of the foregoing observations, that there was considerable aggregate loss during the past year. Reports of advisory officers show that there was serious loss in all districts, but many farms must have been involved where, the disease being less serious, its presence was unrecorded, as well as those where the damage passed unnoticed.

Unfortunately, Fusarium disease cannot be recognized easily by the farmer, as the Smuts and Rusts can be; there is rarely anything to see other than poor growth or unsatisfactory crop, but these symptoms, viewed intelligently, may be good indicators. The causal fungus, Fusarium, is commonly present in arable soils, and persists on many kinds of crop and weed plants as well as on dead residues in the soil. Hence it is probably present on most farms and under certain conditions will cause disease in crops. Cereals appear to be the most suitable host plants, and it is in these crops only that appreciable damage is done. Winter wheat is most frequently and often most seriously damaged, although barley may suffer also as shown by one current record of 75 per cent. loss in the seedling stage.

In spring, an affected crop may show as a thin stand owing to casualties during winter or in early stages of growth, and the standing plants have yellowish leaves with withered tips;

if such plants are lifted, the root system will be found small and the roots more or less brown and rotting (Fig. 1). When *all* the plants are poor and backward the farmer might reasonably attribute it to bad weather, but when defective plants are scattered singly amongst normal ones, or occur in patches, especially on damp or wet parts, he should consider this an indication of probable disease. Whether a faulty crop be due to weather or disease it is customary to top-dress it with a nitrogenous fertilizer. The fertilizer is both a food and a stimulant, and in the latter capacity favours production of new roots which, in cases of disease, function in place of those damaged or destroyed.

Response to the fertilizer, however, does not mean that the disease has come to an end. Affected seedlings that grow on do so under the disadvantage of more or less damaged bases at or below soil level, a condition spoken of as "brown foot rot." They are failures to greater or lesser extent according to the amount of damage done by the fungus at the base during the growing season. Some plants fail to head out at all (Fig. 2); others produce ears, but their weight causes the plants to fall, and the crop appears to thin out between heading out and harvest. As a rule, affected plants remain standing but bear fewer and smaller grains in the ears than do healthy plants, or they become bleached or "ripe" before the time and have no grains in the ears ("whiteheads" or "deaf ears"). (Fig. 3.)

Losses in crops in the ways mentioned, unless serious, are generally overlooked, hence the belief that Fusarium disease takes greater toll of the crops as a whole than might be expected from records of serious losses. Probably many farmers suffer loss in this way, and at threshing time some speak of "plenty of straw but little corn," attributing this to soil, seed or season. Poor crops do, of course, follow from these latter causes, but very often the true cause is a disease organism which escapes the notice of the farmer but could be recognized by a scientific adviser.

The fungus Fusarium attacks the aerial parts of cereals as well as the roots. It reaches these parts by means of spores which are produced mainly about the bases of "foot rot" plants. On the ears of wheat and barley it is sometimes so abundant as to be called "red mould." The occurrence of the fungus on straw and ears is always more abundant in wet seasons, and it multiplies rapidly when the corn stands

Fig. 1 Affected wheat in Spring

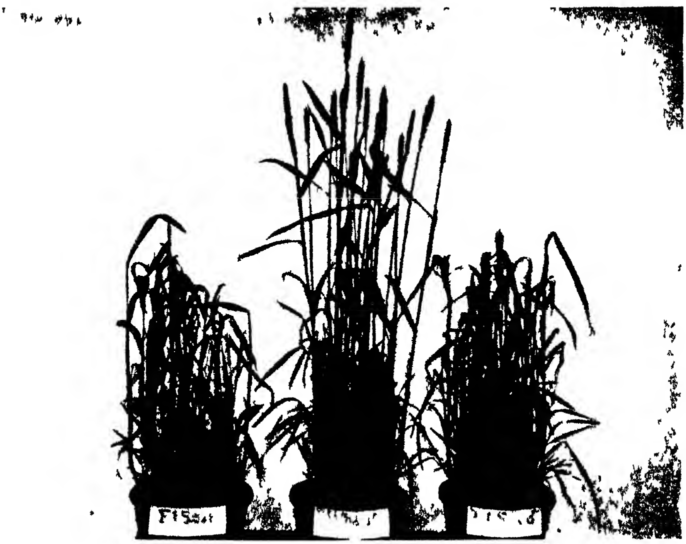

Fig. 2 Effect of *F. culmorum* on wheat

FIG. 3. Bases of "Whitehead" wheat plants.

[*Photographs in this inset by courtesy of the Editor of the 'Annals of Applied Biology.'*]

in stook during a wet harvest period. This happened in 1938 in some districts, especially in the North, where the harvesting of some crops spread over three months and some crops were burned to save carting off useless stuff. It is obvious that much fungal material from the straw and chaff would lodge on the outside of grains during threshing. The "dusting" or "pickling" of seed corn goes far to eliminate fungal material on the outside of grains, and in this respect does much to prevent transmission of the disease by seed. But the fungus frequently penetrates individual grains during the growing period, especially when present as "red mould," and no fungicide applied to the outside of the grain kills the fungus within the grain. Hence "dusting" or "pickling" is not a complete control of seed-borne disease. Thus, as there is likely to be a considerable amount of contaminated seed from the 1938 crops, Fusarium is likely to arise from seed more frequently in 1939 crops than usual, in spite of seed treatments.

Farmers having reason, from the foregoing descriptive account, to suspect disease should seek expert advice from the nearest agricultural college. Quite apart from the current loss in crops, the presence or absence of disease is important in relation to an ensuing corn crop—that is, whether it is advisable to take a second straw crop, whether this should be wheat or oats, whether straw cropping in the ordinary rotation should be modified, and so on. Further, Fusarium disease is not the only one to which such considerations should be applied.

The research work on Fusarium disease of cereals is of recent development, mainly by the present writer during the past ten years. Whilst our knowledge of the disease itself is fairly complete, control measures are as yet but little understood. It is known that the disease occurs on all the usual types of farm soils, that wheat and barley are more susceptible than oats, and that none of the commercial varieties of cereals shows any well-marked resistance. For the present the following suggestions may be applied with advantage where appropriate.

(1) Where a crop shows signs of ill-health or prospects of failure in whole or in part, seek expert advice.

(2) Unless there is reason to the contrary, plough stubble deeply, using the skim coulter.

(3) Do not use seed of doubtful health or poor appearance, and always treat seed with one of the mercurial dusts.

(4) So far as possible ensure good growing conditions with regard to surface drainage, tilth, firm bottom, time of sowing.

For every farmer to have some knowledge of Fusarium disease and to make some attempt to deal with it is one way of increasing the output from corn land, and of increasing his own profit—the overhead charges are as heavy for a poor crop as for a good one. Farmers might well give this matter some thought prior to the sowing of spring corn, and bear it in mind with reference to observation of the autumn-sown crops.

HEN BATTERIES

MARGARET MONTGOMERY

Hen batteries are one of those " new " developments which are not so new as they look. I remember seeing a small one in a Dublin backyard more than twenty years ago. But it is only during the last five or six years that they have become widely used. Many experiments are still to be carried out before batteries can be used—or entirely condemned—for pullets subsequently to be mated for breeding stock, and doubtless further improvements in construction and management will come; but for the commercial egg producer—be he smallholder, general farmer or large-scale poultry farmer—the system is now out of the experimental stage and has proved its worth.

Keeping hens in laying batteries can be made profitable under existing conditions, and this is naturally its chief advantage and one which is equally appreciated by each class of poultry keeper. In addition, there are particular advantages which should not be overlooked. The birds, in their individual cages, are under close control and can, therefore, do no damage to the smallholder's garden; the wood or metal dropping-boards in the cages collect all the manure, and the problem of stale and smelly ground is avoided. The general farmer finds his labour problem solved by a system which relieves the pressure of work at hours when his staff are busy with milking and other early morning and evening chores; automatic trap-nesting gives him a chance to get rid of unprofitable birds which he may not possess sufficient skill to pick out otherwise. The commercial egg farmer, using batteries for his laying stock, finds that labour costs are lower, culling more efficient and, therefore, fewer passengers are carried by the flock, and winter egg production is higher than in intensive houses.

For all these the system varies only in the scale of the equipment, and though the figures, etc., in this article are taken from a thousand-bird commercial farmer's battery, the principles are equally applicable to any size of unit. Small or large, however, the profits depend on efficient layout of the plant and equipment. Bad planning at the beginning

means increased labour costs and decreased health and productive powers of the birds. Opponents of the system argue that birds in the individual battery cages require far more labour than the same numbers in an intensive house. This is entirely a matter of the construction of the battery. My two batteries, containing over 2,000 head, are run by two girls, working 34 hours a week, who do all the feeding, cleaning, egg recording, collecting and packing.

Battery houses fall into two main classes: converted buildings and those especially erected for the purpose. For example: disused cotton mills and a variety of old farm buildings can be adapted, though, if the necessary capital is available, it is better to erect a new building. Details of the alterations required will obviously vary with the previous use of the building, but if it is to house a successful hen battery three things are essential: that the walls and roof should be of material which will ensure a fairly even temperature, e.g., a corrugated iron shed must be lined with matchboarding; light, preferably both side and roof lights so that the birds in the centre banks are not left in semi-darkness; and ventilation. The latter is so important that a ventilation expert should be consulted before any large-scale conversion is attempted. In a battery, one hen is kept to every $2\frac{1}{2}$ ft. of floor space, an allowance which includes its share of the gangways, while in an intensive house, a minimum of 4 ft. must be allowed per hen. If these increased numbers are given insufficient fresh air the incidence of disease may swallow the profits.

A concrete floor is best, though it offers a difficult ventilation problem in an adapted house as, if more than two banks of cages are set up, it is essential to have an air intake under the centre row. With a new battery house a duct can be built in. Three inches of concrete, laid on a foundation of waterproof paper, is cheaper and quite as satisfactory as 5 in. laid on the ground. This type of floor will not show wear, as a wood floor will, where, for example, the food and manure trucks are constantly turned, and it is easy to keep clean, particularly if a pressure hose and a squeegee are provided for swilling.

In addition to ventilation through a louvre at the base of the walls and air ducts in the floor, extractors must be fitted on the roof. A thousand-bird battery, with a double-span roof, should carry two large cowls on each ridge. There

are many good types on the market, but care should be taken that one is chosen which will work in all weathers and not only when a wind is blowing.

Prime Canadian Red Cedar is the ideal material for the walls as it does not require creosoting, a coat of linseed oil being sufficient to preserve the natural oils in the wood. It is rat proof and, if the louvres are screened with fine wire netting, cedar walls and a concrete floor should prevent any trouble from these pests. Corrugated asbestos roofing does not involve the upkeep of retarring and refelting and it protects the birds from unhealthy variation in temperature. The skylights should have small panes so that in summer the sun will not rest too long on any one bird. If the iron girders which support the centre roof valley span the middle cages they will not take up extra floor-space in the gangways. It is important that the latter should be wide enough to allow for the easy passage of food and manure trucks, as attendants who have to squeeze between close-set banks of cages will be too irritable to be efficient. An extra cross gangway in the middle of a large house is well-spent space, especially where mechanical cleaners are used, as the best of these will not scrape a length of more than eighteen feet. The cleaners should be as simple as possible, as Heath Robinson types create chaos when they get out of order. If the wires are coated with tallow it will improve their working.

A laid-on water supply is almost essential. Cleaning and refilling 1,000 separate jam-jars is obviously an uneconomical labour. A completely automatic ball-cock system has its drawbacks, as a very small piece of dirt puts the ball cock out of action, with the disastrous result that the birds are left without water. Continuous troughs with a tap at one end and a plug at the other are easy to clean and can be checked and filled when the attendant is collecting. If they are run down the centre of the cages the drips from the birds' beaks will fall on the droppings trays instead of messing up the record cards and feeding boxes in front.

Battery owners become quite heated in their claims for this or that breed as the ideal battery bird, and again with regard to the advantages (or otherwise) of getting rid of all birds at the end of their pullet year. The controversies are still open and have probably no final answer, since so much depends on local conditions. If the battery owner is breeding his own replacements, a sex-linked cross is excellent. Rhode Island

Red x Light Sussex gives a good layer, and the white-fleshed cockerels are easy to dispose of. The yellow-fleshed Rhode x Wyandotte is an excellent layer, but the table birds are in less demand, and this is also true of the Rhode x Leghorn. A poultry keeper who buys four-months-old pullets for his replacements will find the latter cross splendid layers. Pure-bred birds are quite satisfactory in the battery, but pedigree fowls, which come from stock selected for high egg-yield, may have less stamina and so may not stand up to the artificial conditions in the battery as well as the crossbreds. Even the nervy Leghorns settle down quite successfully in a battery, especially if they have been reared in small units and have been through the trap-nests as pullets.

The breeder who thinks that he can keep his culls profitably in a battery is doomed to disappointment: a few eggs and a heavy death-roll will be his lot. But if their condition is good, birds not quite up to breeding standard, i.e., those whose eye colour, feather markings, or size are " off," will produce more winter eggs in a battery than in an intensive house and their owner will be relieved of the temptation to mate them up if he is short of hatching eggs later in the season!

When battery birds are being kept for a second season's lay it pays to moult them out of doors. There is no truth in the theory that the moult in the battery is of short duration, and the feathers clog the feeding boxes and cleaning apparatus. Each bird should be removed to a semi-intensive house or slatted floor unit as soon as it stops laying, and kept there until a month before it is due to come back into lay. This move affords a chance to spring-clean the cages, a process which is difficult, if not impossible, if the birds are allowed to moult in them. At least a month must be allowed for the bird to settle down in before it is expected to start laying—and this applies also to young stock going in for its first season—or the bird will go into a second, partial moult after entering the battery.

They should be carefully inspected for colds and, if any are found, the sufferers should be treated before they are put into the battery. If the battery house is properly ventilated, colds should be unknown. If a case does occur the bird should be removed at once or the infection will spread through the whole flock. A poultryman whose birds show cold symptoms must make sure that the disease is a common cold and not Laryngo-tracheitis before he starts altering the house

ventilation. To ascertain this, he should send a suspected bird for examination by a Veterinary Laboratory. With Laryngo-tracheitis the discharge from the eyes is frothy instead of being practically clear and blood-stained mucus is frequently coughed up. A cheesy substance is sometimes noticed in the eye and the comb may turn dark purple. This disease has a mortality of from 10 to 80 per cent., and birds that recover may be carriers and infect healthy stock over a long period. The only safe treatment is to slaughter the infected birds before they have time to ruin all the stock.

Economy of labour requires that the battery birds should be fed on dry mash, which can be filled into their boxes once a week from a specially-constructed truck. This vehicle has three wheels, the single front one being on a pivot to make it easy to steer. It has a step across the back, on which the attendant can stand to reach the top food boxes. It is important that these can be got at easily so that any mash left can be pushed up to one end or emptied out altogether instead of fresh stuff being heaped on top. The attendants do not do any serious culling, but they are trained to notice the mash levels as, if a bird has an untouched box in front of her it is a sure sign that she is out of condition and should be removed.

The battery mash must be well balanced, for the birds have no chance of supplementing or correcting their diet, and the poultryman must supply all the essentials for maintenance and production. A little grit should be given on top of their food. A formula which contains about 12 per cent. protein is successful and economical. As the birds can take no exercise, a fattening diet must be avoided. Some farmers advocate pellet feeding, but the birds are inclined to throw the pellets into the gangway where, of course, they are wasted.

One of the great advantages of the battery system is that the eggs, laid on the sloping wire floors of the cages, roll out into a wire trough where the hen cannot foul or break them; from this they can be collected and recorded at the attendant's convenience. This recording is an essential part of the system. It provides automatic trap-nesting, and birds which are not paying their way can be eliminated. The most labour-saving and efficient device is a 7-day dial on the cage front, the total from which can be entered on a chart at the end of the week.

The all-mash ration makes it hard for the birds to eat enough during the dark winter months and, where electricity is available, their day should be lengthened to 14 hours; 25-watt

lamps at 10-ft. intervals are sufficient. Experiment has shown that the birds take more advantage of the extra light if they get it from 4 a.m. onwards. If a time switch is not available, it can be put on by an alarm clock and switched off about 8 o'clock. In some districts, the current at this period costs less than if used in the evening.

Batteries are creating a new class of urban producers. Hens are being kept in disused industrial buildings. Their owners do not breed or rear, but buy layers and use them as animate machines. These plants are in the centre of their market and they can usually sell their manure to gardeners without costly transport, particularly if there are strawberry beds in the neighbourhood. Their superannuated stock has a ready sale as "boilers."

A final word on the matter of costs. The house described, including full equipment, cost £832 9*s*. 10*d*. The wages paid out do not come to more than £1 a week per 1,000 birds, and food costs 8*s*. 8*d*. per year per bird.

FIG. 1. Interior of hen battery, showing iron girder spanning central cage

FIG. 2. Mash truck in use

To face p. 1124

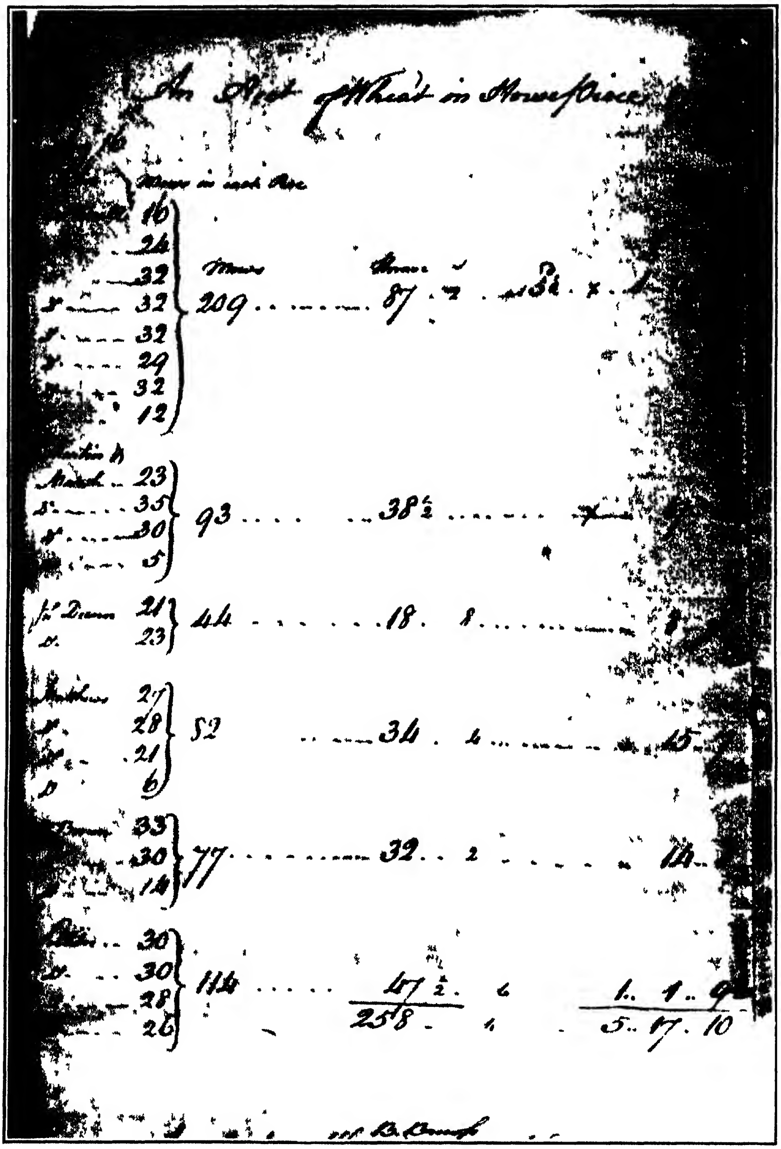

FIG. 1 A section of William Tompson's harvest account

WILLIAM TOMPSON: A RECORD OF GEORGIAN FARMING

W. B. MERCER

The village of Abbots Bromley occupies an island of sand and gravel in the sea of marl which covers most of central Staffordshire. It is a very old settlement. Its straggling street and cottage closes are plain relics of mediaeval times; parts of its church are Norman; its famous horn dance carries the tale back to pre-Christian ages.

William Tompson, who was born here in 1737, came of a family long associated with the village. He was the second son of a substantial farmer and ironmaster. In his youth he had a good grounding in the three R's and throughout his life—he died in 1815—he seems to have recorded every financial transaction of his private and farming life. The surviving records comprise a series of cash and sales books used almost daily from 1772 to 1797 and a ledger covering a period of fifty years.

When he first began to write, the bulk of the village land was enclosed, though many of the householders still held flats in what remained of the open fields and there was at least one common. There were flourishing tanneries and a brickyard; malting and other crafts were carried on; but agriculture dominated all else, and everyone above the status of labourer was something of a farmer.

In 1766 William and his elder brother John became joint tenants of some 300 acres of Lord Bagot's land—it is not at first spoken of as a farm, but as "the leased land." Two years later it was divided into two portions—the Town Farm of 142½ acres, and the Forge Farm. John took the former, married and settled down, with William as a paying guest. William took the Forge. He married in 1779, but does not appear to have lived on the farm until the Forge house was built some ten years later.

The Forge Farm. The Forge Farm was 168 acres of heavy clay land, distant about a mile from the village. It offered few amenities or conveniences, for it was all low-lying land, undrained save for open ditches; the turnpike road certainly ran through one corner, but the homestead was nearly half a mile distant from it. It was rented at £95 at the outset, i.e., 11*s*. 4*d*. per acre, and at £120 per annum from 1786 onwards. In addition, there were levies; their name was legion, though in aggregate they amounted to but £14 or £15

per year; and, of course, there was tithe—paid in kind till 1786, and thereafter in cash.

System of Farming. One of Tompson's earliest memoranda was a list of the fields on the farm and the acreage of each; in certain years the exact acreage under each crop is given, and practically every year the fields in which wheat was grown are stated. From these records it is possible to reconstruct the system on which the farm was worked.

At the outset, every field on the farm save the Lower Benty Leaser and three meadows along the River Blythe, liable to flood, was regarded as arable, i.e., 140 out of 168 acres. But after a few years, some 18 acres were seeded down and left as permanent grass—at all events the Long Meadow and Rough disappear from the list of cropped fields. A further 12 acres was laid down about 1785 and thereafter the farm became 110 acres arable and 58 acres grass.

Stock. Until the homestead was built, he had little live stock. A few stirks or twinters were bought each year from markets or Bease jobbers, the bargain commonly allowing for a trifling Bate, and occasionally becoming involved. As thus:—

> *April* 14, 1780. *Agreed with John Dunn for* 2 *Twinters in exchange, and he to have a heiffer in lieu of them and I to keep him a calf the next summer lay and* 5 *weeks keep over.*

The average purchase price of the stirks may be put at £4 per head. They were sold in the following year as down-calvers or fat, at £7 to £9 per head. In 1786, however, a small dairy herd was got together. Maintained by home breeding, its numbers varied a little from year to year (the exact size can be estimated pretty closely from the records of service dates) but averaged 10-12 cows and heifers and 2 or 3 twinters. After the fashion of the times the cows are described by their colour, origin or characters. One notes, for instance, the Breened, The Yellow, The up-headed heffer,* Nutt nose, Old Rodney, Short Paps, Young Pig, Rough Nan, The lowk horned† one, and the Uttoxeter Heffer. Cheese yields averaged 2½ cwt.—roughly £5 worth—per cow.

A small flock of ewes was maintained, 51 bought in 1775 costing 8*s*. apiece, and hogs were bought from time to time at prices ranging from 11*s*. to 19*s*. From the frequency with

* Cock horned. † Horns curling downwards and outwards.

which couples are mentioned it would seem probable that normally ewes bore but one lamb apiece (" ten couples, four of them double " were, however, entered at lay on one occasion). Evidently they were small sheep since the records of killings show carcass weights of only 8-10 lb. per quarter, and the fleeces were but 2-3½ lb. in weight. They were washed before shearing, and the wool sold at prices varying from 7*s.* 6*d.* per stone in 1779 to 15*s.* in 1787. Lambs were, as a rule, clipped in August. Some losses from Turnhead are noted.

In the earlier years, two or three pigs were bought and fattened annually, slaughtered at home and sold as sides of pork, weights ranging from 300 to 440 lb. dead. In the later years when cheese was being made, sales of pork (at 3*d.* per lb.) ran to about £8 per annum.

The Lay. A small number of lay stock were grazed both summer and winter, the charge for " summer lay in clover, etc.," being 2*s.* per week for a cow, and for " winter lay on stubbles "—sometimes spoken of as lay " at straw "—9*d.*-1*s.* per week for heifers.

Cropping. Tompson's records leave little room for doubt as to his cropping methods. In 1792 he worked out and set down in his day book what he called " a regular mode of follow," grouping his fields to make five courses of 22½, 22½, 22¾, 19½ and 22 acres respectively, and from this date onwards he was clearly aiming at (though not always achieving) a rotation of wheat—beans, barley or oats—seeds or oats—seeds—fallow. Fitches, pease, flax and potatoes were also grown in small quantities. There is no mention of turnips, save a reference to some grown on his brother's farm.

WHEAT. The wheat records are particularly full. White Coan, Dunstable and Essex Dun were the chief sorts used, the seed being bought at a rate slightly above milling rates. Sowing—at the rate of 2¼ strikes* per acre—took place in October or November, and the crop was sometimes eaten off by sheep in February and March—once as late as April 25. Harvesting commenced between August 15 and August 20, though in 1778 " Tom Rowley went with his father a reaping " on August 11. Yields are calculated every year in thraves. In 1775 there is a memo: " The above wheat Horse Piece and Long Meadow proved about 18 str. of an acre through both pieces." This was probably much above the average, for

* Corn prices are always " per strike " or " stricken measure."

in certain years the acreage under wheat is given accurately for tithe purposes, and as the sales book distinguishes between new and old corn it is possible with a fair degree of accuracy to calculate the yields. The average for 8 years in the 1780's so calculated works out at 14½ strikes per acre.

Prices ranged from 4*s*. to 8*s*. per strike throughout the period 1760-95; but a very high figure was reached at the end of the century.

SPRING CORN. The normal order of sowing spring corn was beans, oats, barley; beans being as a rule sown in March, while the others were often sown in April. As regards varieties, the following types of oats are mentioned:—Scotch Grey, White Dutch, Red, Polish and Tartarian. The seed rate was 4 strikes per acre or slightly over. Yields of "30 str. of an acre" are recorded in 1775. Prices were between 2*s*. and 3*s*. per strike throughout the period. The only barley specified is Spratt. Straw was sold regularly—again by the thrave—the largest sales being to titled people, presumably for bedding horses. Prices did not vary greatly, 1*s*. 8*d*. per thrave being perhaps an average.

RYE GRASS AND CLOVER. Rye grass, clover and seeds all figure in the accounts. Rye grass seed was bought and sold by the strike (2*s*. to 4*s*.) while clover seed was sold by the pound at prices which rose fairly steadily from 2½*d*. in 1765 to 1*s*. in the 'nineties. There are records of mowing clover and seeds, and of threshing clover and rye grass respectively. From these facts it seems probable that the two were sometimes grown together and sometimes as self crops. Treafoyle was also used to some extent, the price of the seed being considerably less than clover. White Dutch seed appears once only—in 1802. From the mention of clover lattermath one may safely conclude that this crop was sometimes cut twice. Hay prices remained fairly steady throughout the period at 50*s*. to £3 per ton.

The Follow. The books contain few entries relating to the follow—presumably because all the work was done by regular day labour. But from occasional entries it is clear that the land was ploughed five times; and in an account for work done for a neighbouring farm, a charge of 7*s*. per acre per ploughing is made, while harrowings accounted for a further 6*d*.

It is doubtful how often marl was applied. There were several good marl pits on the farm, and a payment in August, 1774, for "spreading 8 long hundred and 34 load in Over

Benty Leaser "* makes it clear that the practice was carried out, at any rate sometimes.

Manures. There are no entries for manures, save lime, sutt and muck (the word " manure " was either unknown or scorned). Lime was fetched from Burton at a cost of 11*d.* per horse load, i.e., pack-horse load. Sutt was bought from the Uttoxeter sweep at 6*d.* per strike.

Labour. More than 20 names appear in the record of labour for a single year; and in addition there were certainly some children. Six fairly distinct types of labour can be recognized.

(*a*) *The Regular Day Labourer.* In the 'fifties a day labourer earned 10*d.* a day. From 1770 onwards the standard rate was 1*s.* a day, with beer (curiously enough the quantity is nowhere stated) or cash in lieu thereof—as witness the following memorandum under date September 14, 1778:—

> " *Agreed with Henry Mason for* 1 *year at* 1*s. per day and carriage of a load of coles,* 1*d. per day the winter for Beer, and* 2*d. per day the summer, viz., from May Day to Michs. Day.*"

(*b*) *The Casual Labourer.* Weeding, clodding, haymaking and harvesting were the chief jobs for which casual labour was employed. As a rule women and children were engaged for these tasks, women being paid 5*d.* per day, and children 3*d.* or 4*d.*

(*c*) *Piece Work.* The great task of the year for which piece work was employed was, of course, corn harvesting. Wheat was (with the possible exception of 1792) reaped by the sickle. The facsimile facing p. 1125 is a good example of the record which William Tompson preserved of his harvesting wages. As a rule reaping was paid for by the thrave, the rate being 4½*d.* or 5*d.* (3½*d.* in 1758) according to the crop. The sheaves were set up in Mows or stooks of 8, 10 or 12 sheaves.

Where several men were engaged in reaping the same field it was obviously necessary that each worker should preserve some evidence of the amount he had himself reaped; and the custom was for each man to keep one ear from each stook he claimed to have reaped. Sometimes, however, the work was let by the acre, at 6*s.* or 7*s.* An entry in the year 1789

* Over Benty Leaser was 10½ac. $\frac{8 \times 100 + 34}{10\cdot5} = 9\cdot5$.

suggests that the chief deciding factor was the size of the crop, viz:—

Reaping Brooms at 7s.	2	16	10	188	Thrave
Hollowell at 6s.	1	14	6	107	,,
Kesterton's at 4d. per thrave ..	2	5	8	138	,,

As all sheaves were made to a standard size—27 in. in circumference—the heavier crop in the Broom field would obviously have cost more to reap at the standard rate per thrave.

Oats were mown by the scythe and gathered; the standard rate of pay being 1s. an acre for mowing. On one or two occasions Tompson records that he reaped oats at 5s. 6d. per acre.

Hay was generally mown at 1s. 3d. per acre for seeds or clover, and 1s. 6d. to 1s. 8d. (once 2s.) for meadow hay. Tompson notes:—

> 1788. *The three men H. Mason, J. Harris and H. Brown mowing in Blith Meadow, July* 20-28, 6½ *days each* 19½ *days,* £1 7s. 0d.
>
> 1789. *Three men was* 32 *days, cutting the same ground, C. Jackson, H. Brown, H. Mason.*

From which one may conclude either that the 1789 crop was much bigger than that of 1788, or else that C. Jackson was a poor substitute for J. Harris!

Thrashing was also done piece work, the rates of pay for wheat varying from 4½d. to 6d. per strike. Oats cost 2s. 6d. and barley 3s. 6d. per score strikes and clover seed cost 4s. 6d. per strike.

When thrashed, corn was stored before winnowing in a corn hole. This was a square silo, constructed by building a wall about 8 or 10 ft. distant from one corner of the barn, and fixing boards in the fourth side of the enclosure—much in the same fashion as the doors of a modern tower silo are closed. A number of farms in the area still possess corn holes.

Hedging and Dytching was also let by the piece, at 6d. to 8d. per rood (of 8 yd.). Guttering, i.e., cleaning out open furrows, and soughing or draining with faggots and stone was also commonly practised.

(*d*) *The Cottage-holder Labourer.* Some of Tompson's workmen lived in his cottages, with crofts or strips in open fields and owned cattle; nearly all of them bought wheat—generally latter-ends or tail corn—for their own use. Against labour debts there were, therefore, counter-charges for lay of cattle, wheat, beans, hay and so forth as well as rent. The

following may be cited as an example of a landed labourer's account for 1773:—

Feb. 28	*To* 1 *st. of wheat*	–	7	–					
Mch. 20	,, 1 ,, ,, ...	–	6	8					
,, 27	,, 3 ,, ,, ...	1	–	–					
	,, ½ *year's rent due Lady Day* ..	1	10	–					
	,, *Lay of a colt and stirk* ..	–	4	–					
	,, *Carriage of a load of kids from Birchenwood*	–	3	–					
May 23	,, *Cash in full*	–	18	7	*May* 23	*By a Bill (of work)*	4	9	3
	,, ½ *year's rent due M'mas* ..	1	10	–					
	,, *Lay of a stirk, summer lay* ..	–	15	–					
	,, ,, ,, *tup.* 12 *wks. at* 4*d* ..	–	4	–					
	,, ,, ,, *heiffer,* 5 *weeks at* 10*d.*	–	4	2					
	,, ,, ,, ,, 1 *wk* ..	–	–	9					
Oct. 16	,, 1 *st. of L.E. wheat*	–	6	–	*Oct.* 16	*By a bill* ..	6	10	6
		2	19	11					
						By balance	3	10	7

(*e*) *Artisan Labour.* There was very little cash expenditure on tools and implements, but from the ledger accounts it is clear that most of the implements were made on the farm by village artisans, their labour charges in many cases being offset by wheat, beans, barley and malt supplied. In the same way a baker contracted to bake regularly for Tompson, but took his wage mainly in kind, and a builder's account for £16 9*s*. 11*d*. was met to the extent of £8 0*s*. 9*d*. by wheat, haulage and lay of cattle.

(*f*) *Farm Maidservants and Boys.* A maidservant on a farm received a weekly wage of about 1*s*. plus her board. The ledger account for Poll Woodroffe is a record of romance as well as business.

1758–67.	*To* 7 *instalments of wages*	8	–	–	*Mar.* 29, 1758. *Entered into service at* 45*s*.			
Mar. 29, 1767.	*Balance* ..	14	–	–	*Mar.* 29, 1767. *By* 9 *yrs. service at* 45*s*.	20	5	–
					By allowance of 7 *yrs. at* 5*s*.	1	15	–
		22	–	–		22	–	–
1768. *May* 31.	*To cash* ..	2	10	–	1767 *Mar.* 29. *By balance* ..	14	–	–
1769. *Nov.*	,, ,, ..	–	10	–	1769. ,, 2 *years' service*	5	–	–
May 18	,, ,, ..	6	6	–	*By* 5 *or* 6 *wks'. service*	–	6	–
Jne. 12	,, ,, ..	1	1	–				
	Balance due to Mary Mackrory	8	19	–				
		19	6	–		19	6	–

The balance is transferred to Mr. Mackrory's account! Apparently he followed his great compatriot's counsel and married where siller was!

Finance. The records are so detailed and complete that one can confidently proceed to construct from them statements of the annual expenditure and receipts. As there is every reason to believe that the stocks of cattle and produce remained fairly constant from year to year, a statement of the cash account probably gives a fair picture of the true profits. The statements which follow have been drawn up after extracting all the items relating to the ten years selected which appear in the cash book and sales book and checking where necessary by reference to the ledger.

During the first period selected (1773-77) Tompson was lodging with his brother; any produce taken from the farm was accounted for. As has been said, the farm at that time was run almost wholly as an arable holding. In the second period which has been analysed, he was living on the farm with his wife and two children, while two or three servants and/or lads were boarded in. No record is preserved of produce consumed in the house, so some adjustment of the "profit" calculated from the cash book must be made. During this period a small herd of milking cattle was maintained and cheese was made.

Expenditure

	1773-7			1790-94		
	£	s	d.	£	s.	d.
Rent	95	–	–	120	–	–
Rates, etc. ..	14	7	6	33	11	2
Seed	17	15	9	6	19	8
Malt and Hops	7	3	11	20	–	4
Lime	3	18	9			
Cattle	30	1	7	3	18	10
Sheep	11	15	1	15	19	–
Labour	95	5	4	90	4	7
Sundry	19	10	5	25	3	9
Horses	—			11	12	3
Pigs	—			3	4	–
Balance ..	89	–	2	58	14	5
	383	17	8	389	8	–

Income

	1773-7			1790-94		
	£	s.	d.	£	s.	d.
Wheat	117	18	10	113	19	4
Beans	61	3	1	39	4	2
Oats	44	10	–	44	19	5
Straw	10	16	6	8	7	3
Vetches ..	18	11	8	—		
Hay	16	8	–	—		
Sheep and Wool	35	16	7	39	3	5
Cattle	52	7	10	44	1	4
Sundry	26	5	2	10	3	–
Wheat to men	—			8	10	9
Cheese	—			67	19	10
Pigs	—			8	8	10
Rye Grass ..	—			4	10	8
	383	17	8	389	8	–

The accounts show a consistent favourable balance, amounting in round figures to £90 per annum in the earlier period and £60 per annum in the later period. Considering the standards of the times, a profit of £90—equal to the rent, or six times the income of a labourer—represented a good living. Judged on turnover, it amounted to a profit of 25 per cent. The true profit of the later years cannot have been much less, despite the increased rent.

A GLASSHOUSE UNIT ON A MIXED FARM

C. W. Whatley,
Burderop, Swindon

Glasshouse development in this country hinges very much upon the demand for luxury products which can only be produced under glass. Glass gives control over a growing crop, i.e., control over the elements, not of disease. For instance, when a frost is evident, one puts more coal into the heating furnace, and when the sun is too powerful, one opens the ventilators to let in more air.

It may be that my mind was influenced towards the production of crops under glass by the fact, which I sometimes think is little realized by English farmers, that England is the home of good living; incidentally, where could one find a bigger volume of consumers in a given space, who are living far beyond the bread-and-cheese stage? In fact, they have the will, and the money, to buy luxury products, when those products are available at a reasonable price; then surely it must be a good proposition to make an effort to cater for this special market. In times of uncertainty, of course, expansion in this direction may be restrained, but assuming that a period of reasonable stability can be looked for, my purpose is to give an outline of measures that can be adopted in efforts at departmental farming, including crops under glass. In giving this outline, let me say that I am very conscious of many weak links in the chain which holds my various departments together. At the same time, on many farms, on large holdings in particular, I am convinced that they can be very well linked. Perhaps on my own farm these links would show more strength did youth and energy serve one better.

In conjunction with my brother I am farming about 2,000 acres in North Wilts. The character of this land is very variable, which perhaps is favourable to the practice of many departments in farming. I may describe this holding under three categories, viz., (1) 700 acres of good and light pasture, (2) 700 acres of heavy and light arable, (3) 700 acres of enclosed and open Downs and about 2¼ acres under glass. Though we may be wrong, we believe that we get the best results from this mixed holding by making an effort to turn out maximum quantities of milk, corn, mutton, bacon, tomatoes and a small quantity of beef.

Perhaps it would be as well for me to mention that there

is also a side line to the business by way of winter threshing, which occupies twelve men during the winter months. A selection from these men is available during the summer months, in order to provide extra labour during the stress season.

Milk. To deal with these various branches of farming in the order given, and certainly in order of importance, I must first say a few words about milk.

For many years this line of farming has been looked upon as trustee stock. It may, or it may not be a good yielding stock, but its attraction is that it gives that certainty of income which comes in so handy to meet the weekly wage bill.

It is our practice to keep in milk about 200 cows all the year round. These are divided into three dairies, two of which are T.T. herds, and the other needs no description.

The illustrated block of buildings (Fig. 1) gives an idea of the layout for milking about 120 T.T. cows. The corrugated shed, of rick-house type, in the foreground, is the milking parlour, and the buildings surrounding the square yard on three sides are the winter quarters of the cows. A particular advantage to the situation is that the pastures, some 200 acres in extent, lie around the dairy site; five fields, at least, have access to the premises. The whole enterprise lends itself particularly well to handling a large herd of dairy cows.

In the milking parlour we have installed a nine-unit Alfa Laval combine milking plant; incidentally, the odd unit is completely quartered off to deal with animals during the process of isolation. The new regulations call for a provision of some sort during the first two months after purchase, previous to entering the main herd.

This combine system of milking parlour, although expensive, costing as it did about £700 including the building, works very comfortably and efficiently. A good feature of the layout is the twelve washing stalls arranged along the back line, where the cows are washed and groomed before milking. Another good feature of these washing stalls is that they give a nervous cow an opportunity to relieve herself before passing into the milkers' hands, which certainly adds to the cleanliness of the milking stalls.

Now a word about attestation. Unless one has a self-contained herd, I feel the effort is useless. It is a much easier proposition, too, with a smaller number. For the time being, therefore, I have decided to keep in the third gear.

Photograph by courtesy of 'Farmers Weekly'

FIG. 1 The Buildings at Burderop

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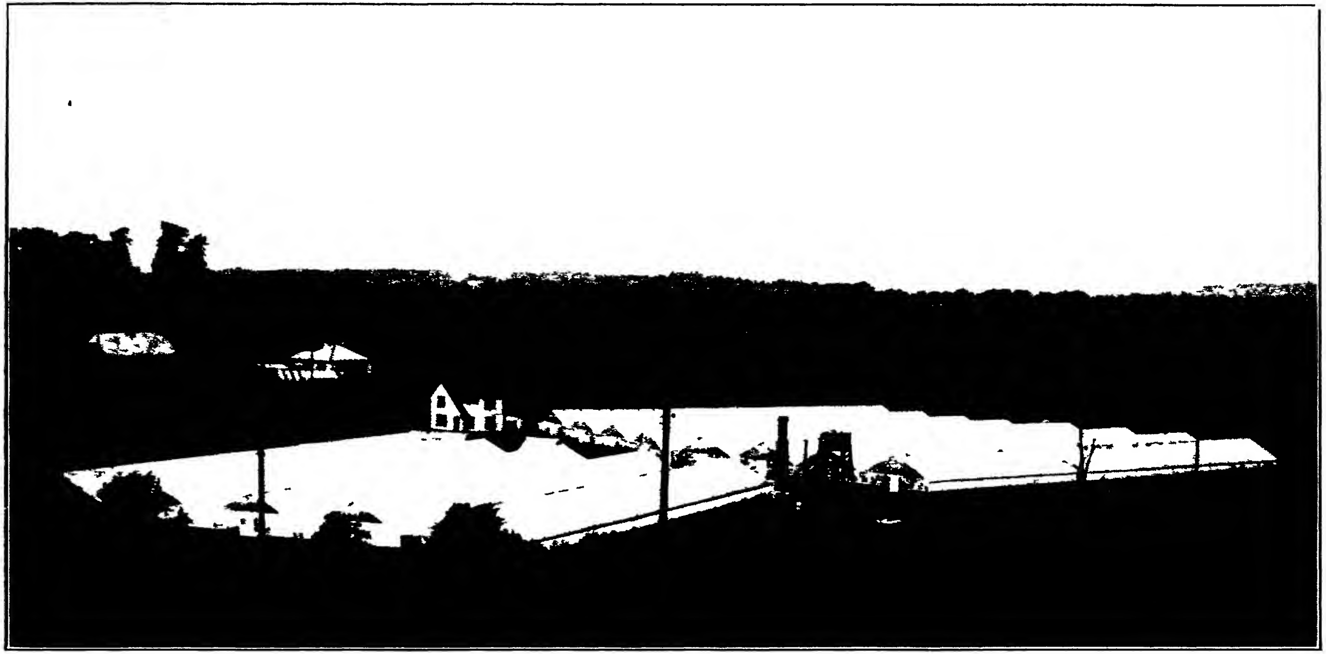


Photograph by courtesy of Messrs Duncan Tucker (Tottenham) Ltd

FIG 2 The Glasshouse Unit at Burderop

Unfortunately, my strong pastures are totally unsuited for young, growing cattle, and I have of necessity continually to buy refills or replacements, to keep up the output of milk. In selling T.T. milk on a contract of level deliveries, one has to go into the market from time to time, notwithstanding that one may have made an effort to avoid doing so.

I could, no doubt, dispense with the small T.T. dairy on the light land, wean and carry all the young stock on this farm of light character, but I hesitate to make the change, being fearful of a reduction in the milk cheque.

I mentioned above that some of my departmental links were weak, and there is a weakness here. What ought to be done is to take another farm for the sole purpose of weaning and rearing dairy stock. Before I finally leave the dairy side, let me say it is a distinct advantage, when handling a large herd by a milking plant, to have the animals in two divisions, the light and the heavy milkers. The heavies can feed the best pastures, and be the first to occupy the milking stalls in the morning, and the last in the evening. The latter arrangement gives them a distinct advantage in the spread of milking hours.

I like using Black Angus bulls or perhaps a Hereford, in any case a beef type. It may be a fancy, but I rather think we get less sterility and abortion.

Finally, may I say that I am not a believer in milking machines for less than 60 cows, as with less than this number there is very little economy in labour.

Corn Growing. On the 700 acres of arable land our object is to turn out about 400 acres of corn. Wheat, of course, is the main crop. Like every other farmer to-day, we aim at growing every acre of wheat possible. In doing so I am satisfied that the hurdle flock, on which I will comment in due course, is a great asset. To grow anything like a crop of wheat, land must be in good heart. If one did not keep the hurdle flock, then one must resort to the dung cart, and the latter involves even more labour than the former, or at least I am inclined to think so.

The four-course system is practised on the lighter lands; in fact, it is difficult to organize on any other, when a hurdle flock has to be provided for, but on the heavy soils, the three-course system prevails. On occasion a field which has received very liberal treatment, is cropped with wheat two years in succession. It is certainly more remunerative than winter oats, and to plan for a spring corn crop on the heavy land

one may fall up against a wet spring, and then lose a crop altogether.

Sheep. From my youth up, the Hampshire Down breed has always held a fascination for me, and I rather think some of the breed will be found on the holding the day I hand over. They cannot be beaten for the purpose of folding, and they are not a coarse, heavy breed, to be discarded because the consumer wants more meat and less bone. For early production the lamb is foremost in the ranks of hurdle sheep, but I do feel at times that his owner holds on to him just a little too long, and then, in the last two months just loses the cost of his keep. For crossing for early maturity this breed has rightly become one of the most popular.

Enquiries for crossing purposes have encouraged me to turn out in October about 60 ram lambs from a pedigree flock of 400 ewes. In making a bid for the October trade, I find lambing this hurdle flock in February is quite early enough, and it does save a month's keep.

Bacon and Beef. These are features of minor importance in our farming activities. For instance, one has little room for beef when milk is a strong feature of output, but we aim to win a few prizes at Christmas time in the local show ring. Perhaps a few young barreners are fattened out during the summer.

The output of bacon pigs is in the neighbourhood of 300 a year. I am very conscious that this number should be increased, for I have no doubt that bacon production is a branch of farming that one should not hesitate to develop, but here again, I do not feel disposed to entertain the idea of laying out the necessary capital for a modern fattening pighouse, on Danish lines, although I do know that those who have taken hold of their courage and developed in this direction, have received a good return on their outlay.

It may sometimes be all right to have a few pigs about in odd corners of the buildings, but a few odd pigs have no place in departmental farming.

Tomato Growing. This, of course, is a new departure. Most probably its measure of success has been derived from the fact that we are in close proximity to a town of 60,000 inhabitants, which, I must be careful to add, has no other "local grown" supply. This in itself I believe to be a great asset, and one that I feel cannot be disregarded in any

development of this nature. There are, of course, many other factors which do want very careful thinking out. We were perhaps very fortunate in being able to select a sheltered site on a deep loam soil, with a chalk subsoil. We had rather a shock after making a start, on being informed that a chalk soil was not looked upon as being suitable for tomato growing. We have disproved this contention, however, and it must be accepted that a good average crop has been grown during the four years that we have been in operation.

A good water supply is imperative. Fortunately, our nurseries are laid out in close proximity to a brook which has a reputation of never running dry, and so far it has kept up that reputation.

Another point to consider is that one should have an eye to expansion, and not lose sight of a few extra acres for this purpose. While I do not feel that we made many mistakes in the layout of our 2¼ acres, there probably are some. A lot of careful thinking should be done to avoid loss of space; for instance, a packing shed should be in the centre, to make the most of the labour. This last point is a most important one, and cannot be stressed too strongly.

Roads need not be too complicated or expensive. Old railway sleepers make a very serviceable road, and form a good base on which the clinkers from the stokeholds can be continually laid. This in time forms a road even strong enough for heavy lorries.

Having covered the layout to some extent, we must deal with the question of management. This, of course, is the deciding factor of success or otherwise, and one must exercise the greatest care in selecting a foreman. First of all, he must thoroughly know his job of growing the crop. This again is not sufficient unless he is a leader of men. How seldom do we find this type of man. When found, he can, and does, command a good wage, plus a bonus on the crop grown. This foreman must have a cottage on the spot with a telephone at his disposal.

The labour costs in growing an acre of tomatoes is in the region of £600, this figure, of course, would vary according to the rate of pay in the area. An average crop should give 40 tons per acre.

Catch Cropping. I am well aware this can be, and is, practised by many nurserymen, but I believe it can be carried to excess. For instance, you may be held up in the early

spring by a crop of lettuce meeting a bad market. This will probably throw your tomato crop out of season, or at least it will give you a setback.

My experience has been that it is a full, early crop which eventually brings home the best return; but let me not be misunderstood, as we have several houses at the moment carrying a crop of lettuce. But if one is not careful, the law of diminishing returns becomes operative.

Bulbs and chrysanthemums are again good propositions in the right district. We may have been unfortunate, or perhaps it may have been from lack of knowledge and experience, but, whatever the cause, with us they just about covered costs and very little more. On the other hand, something of this sort does keep you in touch with your customers.

I very well remember discussing the whole proposition with a very knowledgeable nurseryman in the early days of our venture, and his advice was, " Don't be bothered with a lot of spare ground outside the actual glass. You will find it a continual nuisance." I do not think he was far wrong.

Management. I must refer to the dovetailing of these various branches of departmental farming. I find that for smooth running one must try to work them in units, but not watertight units, otherwise one would not help the other. Take, for instance, lorries. Our milk is delivered daily to London, loading back with feeding stuffs. This entails an outlay of two lorries, one to act as a spare. This spare is available to wait on the nurseries, to carry coal and stable manure; the farm, of course, provides the latter. The home lorry is again available to do the farm hauling, and to haul out the coal to threshing sets operating in the district. The work of the threshing gangs is finished about April. Should this seasonal work hang on unduly, my nursery foreman begins making enquiries when the threshing will be finished, because, as he says, " I must have my summer supply of labour, my crop is getting unmanageable." Perhaps I have said enough to give an idea of the advantages derived by letting each branch help another out in time of stress, thereby reducing labour costs.

Of late years we have wound up our yearly activities with a Harvest Home in the barn, when the men in each branch have an opportunity of learning about the progress or otherwise of his particular branch, and about the business as a whole.

THE RESIDUAL MANURIAL VALUES OF FEEDING STUFFS CONSUMED BY LIVE STOCK

CHARLES CROWTHER,
Harper Adams Agricultural College

The consumption of food by live stock gives rise not only to nutritive effects within the animal, but also to excreta in the form of faeces and urine, which have valuable fertilizing properties when applied to the soil. Where these excreta come from imported feeding stuffs they clearly represent a transference to our own soils of some part of the elements of fertility from the soils of other countries, and in that respect offset to some extent any disadvantage that the imports may inflict in other ways upon our farming economy. Our annual import of about 7¾ million tons (1935) of cereals and other concentrated feeding stuffs represents probably about 150,000 tons of nitrogen, 80,000 tons of phosphoric acid and 50,000 tons of potash, of which amounts something like one-third to one-half probably reaches the soils of our farms. These are very large amounts, and indicate the importance, from the point of view both of the nation and of the individual farm, of the proper conservation and utilization of the manure containing the residues from these foods.

It is not the purpose of this article to deal with the general question of the making and conservation of farmyard manure, but rather with that of the nature and value of the contribution made to the fertilizer assets of the farm by the consumption of purchased foods. On the general question it must suffice to say that, broadly speaking, losses of manurial value will be reduced to a minimum if the manure is either quickly incorporated in the soil or stored in a compact heap, protected from the weather and from losses by drainage.

Of the two excreta arising from the food, the solid excrement (faeces) represents the undigested matters, whilst the urine carries away such amounts, if any, of the digested fertilizing matters as the animal cannot utilize, plus those liberated in soluble form from the tissues as a result of the normal vital activities.

Most of the animals kept on the farm are engaged in the production of materials that contain nitrogen, phosphorus and

potash, e.g., flesh, bone, milk, wool, eggs. Hence, with all these, the total excrements obviously cannot contain the whole of the manurial ingredients that the food supplies. Some portion must be retained in the body-increase, milk, etc., produced by the consumption of the food.

The amounts thus retained vary greatly with different classes of animals, being especially great in young, growing animals, cows in full milk, and laying hens. Milk, for example, usually contains about 0.55 per cent. of nitrogen, 0.2 per cent. of phosphoric acid, and 0.15 per cent. of potash, so that at current unit costs of these ingredients in fertilizers every gallon of milk will carry away rather more than one farthing's worth of "manurial value."

Similarly, in one of my own experiments with growing pigs, the proportion of the food nitrogen recovered in the combined fresh excreta at different stages of growth over a period of 22 weeks ranged from 44 per cent. at first to 68 per cent. at the end; that of phosphorus from 45 to 71 per cent. and that of potash from 67 to 98 per cent. It is further of interest to note from this experiment that, of the manurial ingredients recovered, 65 per cent. of the nitrogen, 23 per cent. of the phosphorus, and 82 per cent. of the potash were in the urine, representing together in terms of money value more than 60 per cent. of the value of the total excreta; this point will be more fully discussed later.

The adult fattening animal, on the other hand, with frame fully developed or nearly so, retains in its body only a very small proportion of the nitrogen, phosphorus and potash of the food, so that practically the whole of the manurial ingredients consumed in the food are voided in the excreta.

The distribution of the voided nitrogen between the faeces and urine varies greatly according to the digestibility of the food and the class of stock consuming it, but practically the whole of the voided phosphorus is in the faeces, whilst 80 per cent. or more of the voided potash is in the urine. Whereas, therefore, the solid excrement contains appreciable amounts of nitrogen and phosphorus, but little potash, the urine owes its fertilizing value to its content of nitrogen and potash.

As far as the nitrogen is concerned there is a further important qualitative difference between the two excreta. In the faeces the nitrogen is present almost entirely in the form of insoluble organic compounds which have already, during their passage through the digestive tract, run the gauntlet of

various ferments and bacteria, and hence are not likely to liberate their nitrogen quickly in the soil. In experiments, the availability of this nitrogen has, in fact, usually been found to be no more than about one-quarter of that of nitrogen in soluble forms. For similar reasons, a part of the phosphorus in the faeces is also of low availability.

In the urine, on the other hand, the whole of the nitrogen is in the form of soluble, easily fermentable material, which ranks with the quickest-acting of the fertilizers. Any failure to collect and utilize the urine, therefore, involves loss of the most valuable part of the excreted nitrogen, as well as of the potash, and, as seen in the example quoted above, may amount to a very large fraction of the total manurial value of the food. A total wastage of urine would almost certainly mean a loss of at least 70-80 per cent. of the full manurial value of the food.

The necessity for assessing the value of the manurial residues derived from the consumption of food arises in practice chiefly in connexion with the valuation of "tenant-right" at the close of a farm tenancy, since the outgoing tenant is entitled to claim to be paid for such unexhausted manurial value from foods purchased by him as he may be leaving behind. In principle, the claim appears to be sound and straightforward, but in actual practice, despite some seventy years of intermittent controversy and investigation, the problem of devising a workable basis for the assessment of these "residual manurial values" with even approximate accuracy has yet to be solved.

It is true that the basis of computation devised by Hall and Voelcker in 1902, with slight subsequent modification, has been generally accepted by valuers, but unfortunately it is applied with a rigidity which the method does not warrant and which was certainly not intended by the authors, whose declared object was "to place in the hands of the valuer reliable material to guide him in framing his conclusion, and to give him information on points which lie outside his special sphere."

The method of Hall and Voelcker is based upon four sets of estimates:—

(1) The average content of nitrogen, phosphoric acid and potash in different feeding-stuffs.

(2) The probable losses of these ingredients in the making, storage and application of the farmyard manure in which they are incorporated.

(3) The average costs per unit of nitrogen, phosphoric acid and potash in fertilizers.

(4) The average rate at which the manurial residues from the food are used up by successive crops.

In every instance the data used are estimates, and the method is therefore purely conventional, since the final result is affected by a change in any one of the estimates. The data used by Hall and Voelcker under (1) for example, doubtless represented the best available at the time of their Report, but they are not necessarily the averages one would tabulate to-day. Similarly, some revision of their estimates under (2) and (4) may be desirable in the light of subsequent experimental work.

As to (3), there is no difficulty in calculating the average unit costs at any particular time, provided we have an agreed basis as to the fertilizers to be included and the precise way in which the price of each is to be arrived at; but the average unit costs will vary with each change of fertilizer prices. In the Hall and Voelcker scheme, and in its subsequent practical application, the unit values taken are the averages assessed from a variety of common fertilizers, including a number of relatively expensive organic manures, but the incoming tenant may well object that he could replace the nitrogen, phosphoric acid and potash he is being asked to pay for at much lower cost in the form of the fertilizers with low unit costs.

As against this may be set the consideration that the residues from food supply not only nitrogen, phosphorus and potassium, but also a certain amount of organic matter, which, as humus in the soil, has a considerable indirect fertilizing value through its physical properties, such as those which affect the conditions of aeration, moisture and temperature, whilst it may also stimulate the activity of bacteria and other fermentative organisms in the soil. No direct allowance is made for this in the Hall and Voelcker estimates, but the inclusion of organic fertilizers such as rape meal, bone meal, etc., in the list of fertilizers on which the average unit cost of nitrogen is based may be regarded as giving some rough measure of compensation.

The amount of this organic matter contributed to the manure heap from the food varies with different classes of foods according to their digestibility, being naturally highest with the more fibrous and less digestible foods. Thus, one

ton of average hay fed to cattle will leave about 8 cwt. of organic matter (dry), one ton of oats or bran about 5-6 cwt., and one ton of non-fibrous concentrates about 2-4 cwt. In terms of wet humus with 75 per cent. of moisture, the amounts will be four times the quantities indicated. From these figures a rough estimate may be made of the allowance for organic matter that is incorporated in the Hall and Voelcker figures at present in use. The average unit cost of nitrogen is taken at 10*s*., whereas the unit of nitrogen can be purchased to-day in sulphate of ammonia for about 7*s*. 3*d*. If the latter figure were taken the "allowance" in respect of linseed cake, for example, would be reduced by about 7*s*. per ton, and this may be taken, therefore, as the allowance made in Hall and Voelcker's figure for the 3½ cwt. of dry humus (or 14 cwt. of wet humus) added to the manure by the consumption of one ton of linseed cake.

Perhaps the most debatable of the Hall and Voelcker estimates is that of the loss of food nitrogen involved in the collection, storage and utilization of the excreta, which is taken at 50 per cent. of the amount present in the food. Scientific opinion has long been agreed that this is too low, and the Committee which reported in 1927 (this JOURNAL, Vol. XXXIV, p. 401) recommended that the figure should be raised to 60 per cent. This view is supported by the widespread belief in practical circles that the evidence on which Hall and Voelcker based their conclusion was obtained too largely under conditions superior to those that prevail on the average farm. On the other hand, they stress the fact that the first losses, due to fermentation of the more soluble matter, such as occur even under ideal conditions, are the heaviest, and that subsequent fermentation losses, even under conditions of full exposure to the weather, are relatively small. They probably underestimated, however, the losses arising from wastage of urine, the possible magnitude of which was indicated in an earlier paragraph. This loss is undoubtedly very large on many dairy farms, and in all cases should be taken into consideration by the valuer.

Reference has already been made to the influence of the class of stock consuming the food upon the amounts of nitrogen, phosphorus and potash excreted, and in this connexion one must bear in mind that the Hall and Voelcker values were primarily designed in respect of food consumed by fattening cattle.

If they are equitable for this, then they are certainly too high for food consumed by milch cows, growing stock and laying hens. With regard to dairy cows, the 1927 Committee recommended that a deduction of one-third should be made from the Hall and Voelcker allowances, and in my own experiments with growing pigs referred to above the conclusion was reached that a deduction of one-fifth would be equitable. At present no claim can be made for food consumed by poultry, but were this to be brought within the Act the values applicable would undoubtedly be in line with these lower values. In the practice of valuation such discrimination is, of course, only possible where the evidence is clear as to how the food has been distributed between the different classes of live stock. With the increased specialization of to-day, such instances are probably far more numerous than in the pre-War days when the present practice was designed.

On only one point did Hall and Voelcker consider a separate basis of valuation to be worth while, namely, where foodstuffs were consumed directly on the land. In view of the reduced possibilities of loss of manurial ingredients in such circumstances, they included in their 1913 revision an alternative table of allowances, differing only from the standard table in that the loss of nitrogen was assessed at 30 per cent. instead of 50 per cent. In practice, however, it is commonly even more difficult to determine the allocation of the food between indoor and outdoor feeding than between different classes of live stock. Moreover, the returns from food consumed directly upon the land are extremely variable, especially as regards grass land. In their review of this subject, the 1927 Committee came to the conclusion that there was no valid case for making higher allowance for food consumed even on arable land, and that as regards grass land a reduction rather than an increase would be more in accordance with the facts. In valuation practice the separate table was, in fact, not widely adopted, and opinion to-day seems unanimous in favour of having the one basic table of values on which any adjustments that may be thought necessary in special cases can be made by percentage decreases or increases.

Within the limits of this article it is not possible to touch upon more than a few aspects of the practical problem, but enough has perhaps been said to indicate its complexity, even up to the stage of application of the manurial residues to the

land. From this stage onwards the difficulties multiply fast. The basic assumption underlying the whole system of valuation is that the nitrogen, phosphorus and potash which pass from the foods into the manure can be as effectively utilized as if the same amounts of nitrogen, etc., were applied in the form of separate fertilizers. Strictly speaking, this can only be true where the soil is deficient in all three items of plant food, with special deficiency in nitrogen. Farmyard manure is always "over-balanced" with regard to nitrogen, and the incorporation in it of residues from concentrated foods, although it enriches the manure all round, only serves to intensify this lack of balance. Apart from this, the quantities in which farmyard manure is commonly applied may introduce an element of difficulty in securing the full benefit from the richer manure. Thus, a manure made from roots, hay and straw only might contain 0.4 per cent. of nitrogen, whilst similar feeding with the addition of concentrated food might raise the nitrogen-content to 0.6 per cent. A dressing of 10 tons per acre of the former would supply 90 lb. of nitrogen, and of the latter, 134 lb. But 90 lb. of nitrogen is equivalent to a dressing of 4 cwt. of sulphate of ammonia, which on most soils would not seem to leave much margin for the effective action of the extra nitrogen—equivalent to another 2 cwt. of sulphate of ammonia—contained in the richer dung. This doubtless accounts in part for the disconcerting results obtained in some instances where dung made by cattle consuming food of high "manurial value" has given no better results than that made by stock receiving concentrates much poorer in manurial ingredients. Nor can we escape from the dilemma by giving a proportionately smaller dressing of the richer dung; in our example, 7 tons instead of 10 tons; since our primary concern in using dung at all is to assist in maintaining or increasing the stock of humus in the soil. The solution may perhaps lie in increasing the supply of litter where food of high nitrogen-content is being used, so that instead of producing a rich dung, a greater mass of dung of average nitrogen-content may be secured.

The problem of securing full value from the dung is particularly difficult on the grass farm, and is indeed insoluble if the farm be heavily stocked, or as is not infrequent in some areas, actually overstocked in relation to the area and character of the farm.

The only general conclusion to which the scientist can come

from a survey of this problem of the assessment of compensation values for unexhausted manurial residues arising from the consumption of feeding stuffs is that it is impossible to do more than indicate a rough datum line from which the valuer can work, leaving to him the responsibility of the final decision in each specific case, in making which he should also take into account all other factors observed by him which from his experience he knows to have an important bearing upon the value of the " improvement " likely to have been effected by the feeding practice of the farm. The Agricultural Holdings Act does not impose on him any obligation to use the Hall and Voelcker table, but it is the only " datum line " provided for him as yet by the scientist, and probably, despite its crudeness, if used as such it does generally ensure that justice is substantially done. Unfortunately, it is not so used, but the common practice is to apply the values rigidly to all cases, whereby on occasion results are obtained that are patently absurd in the light of practical experience. It is this abuse of the table that justifies most of the criticism to which it has been subjected. One can sympathize with the valuer's desire to have a simple and clear-cut method of assessment, and with the farmer's desire for a permanent basis that will ensure him being valued out of his farm as he went in, but both parties must realize that this is an ideal towards which science can as yet only provide the first steps.

LAND DRAINAGE IMPROVEMENT WORKS CARRIED OUT BY THE ROTHER AND JURY'S GUT CATCHMENT BOARD

The importance of land drainage in the area of the Rother and Jury's Gut Catchment Board may be readily appreciated from the fact that, of its total area of 294 square miles, no less than 75 square miles are lowlands deriving special benefit from drainage works. Prior to the constitution of the Board, many of their present duties were performed by various authorities, namely, the Drainage Commissioners for the Kent and Sussex Rother Levels, the Commissioners of Sewers for the Level of Walland Marsh and Elderton's Innings, the Commissioners of Sewers for the Level of East Guldeford, the Commissioners of Sewers for the Rapes of Pevensey and Hastings, and the Tillingham Valley Drainage Board. The areas administered by these authorities have been reconstituted into three Internal Drainage Districts—the Rother, the Walland Marsh, and the Pett. In addition to their responsibility for 120 miles of " main " river, the Catchment Board have jurisdiction over some 10 miles of embankments that face directly on to the open sea and protect large areas of lowlands from tidal inundations. By virtue of their powers under Section 40 of the Land Drainage Act, 1930, the Board have also taken over the powers and duties of the former Commissioners of Rye Harbour.

The Rother area is of great historical interest, forming as it does, part of the Romney Marsh, one of the earliest areas on the South Coast of England to be reclaimed. In earlier days, when the towns of Rye and Winchelsea were flourishing members of the Cinque ports, a constant struggle was maintained to keep the harbours clear of the shingle drift from the west, the question of land drainage then being of secondary importance. It was not until the 18th century that the Rother was diverted into the Tillingham and Brede, separate harbours having existed up to that time. At the same time a new harbour entrance was made at Pett, some two miles to the west of the present position, but this quickly became blocked by the eastern shingle drift and in 1803 a new channel was opened on the site of the present entrance. This new harbour, too, soon became blocked and, in 1812, the aspect of land drainage having become of greater importance, John Rennie

was called in to advise on measures to clear the channel. His report was followed by those of Sir William Cubitt in 1839 and Sir John Coode in 1879, the former being responsible for the construction of the present Scots Float sluice and lock about 4 miles from the mouth of the river, which make the head of the tidal compartment of the river. By 1919, conditions had become progressively worse, and an application was made by the Drainage and Harbour Commissioners for Government assistance. A survey was made and a scheme prepared by Mr. C. H. J. Clayton, M.Inst.C.E., the then Chief Drainage Engineer of the Ministry of Agriculture and Fisheries, but owing to lack of support the scheme was not carried out. Conditions became still worse, and by December, 1923, the drifting shingle had formed a spit which almost completely closed the mouth of the Harbour. Fortunately, by that time funds had become available out of monies provided for the relief of unemployment, and works were carried out involving the construction of a groyne on the west side of the entrance and a timber extension of the masonry training wall on the east side. The effect of these works, which were described in this JOURNAL for June, 1925, was to weaken the shingle spit to such an extent as to enable it to be cut through. Relief was provided by these works but accumulation of shingle continued farther seaward. By 1926, unsatisfactory conditions again prevailed and Mr. Du-Plat-Taylor, M.Inst.C.E., was asked to report. His scheme, to which the Government contributed 50 per cent. of the cost, comprised the following works: (*a*) the construction of a substantial groyne on the west side of the harbour, some 1,560 ft. in length; (*b*) the dredging of the tidal river; (*c*) the construction of a training breastwork of steel piling on the west side of the channel to limit the low-water channel on that side; (*d*) an improvement at the confluence of the Rother and the Rock Channel, the latter of which carries the water of the Brede and Tillingham; and (*e*) the construction of a new sluice on the Tillingham at the head of the Strand Quay.

These brief historical notes will serve to indicate that the problem of land drainage in the Rother Area is no new one and that, for the area to survive, a constant struggle against the elements has been, and for that matter always will be, necessary. Since the constitution of the Catchment Board, extensive works have been rendered necessary and the Board have wisely taken full advantage of the opportunities afforded

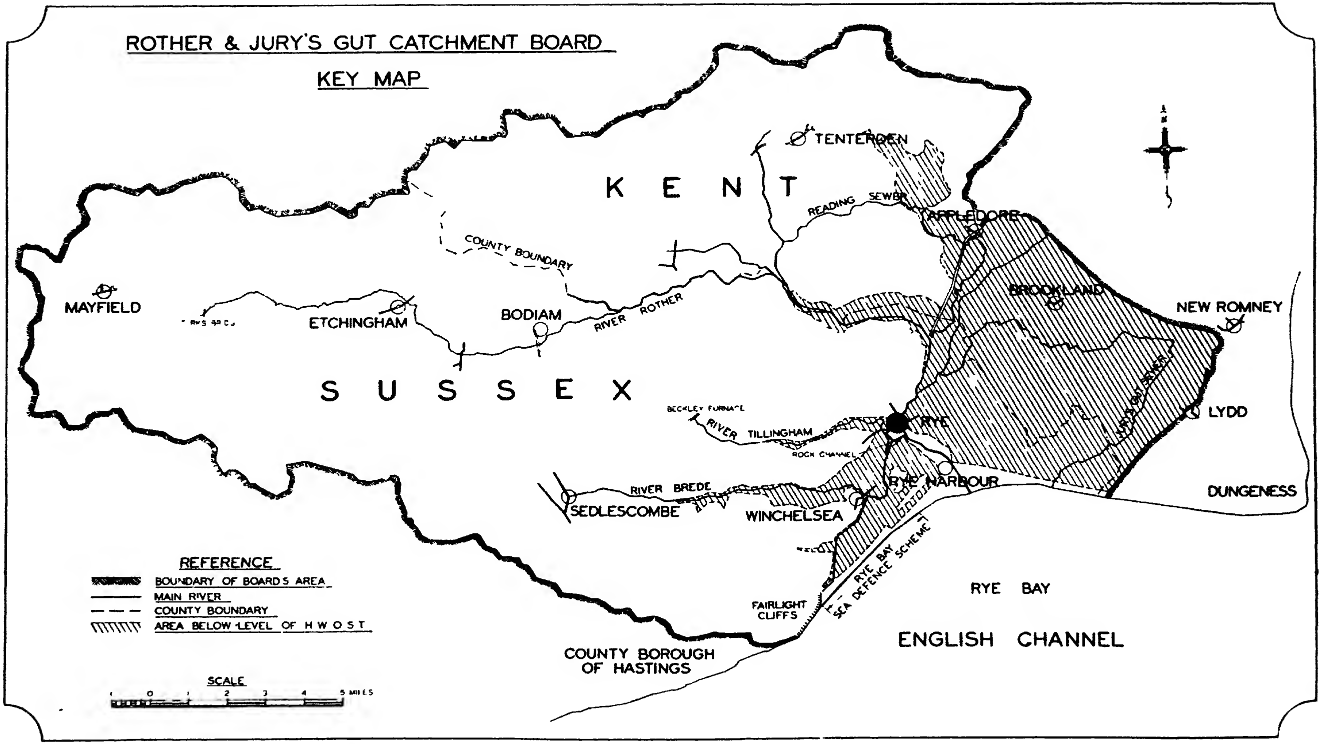


FIG. 1 Key Map of Rother and Jury's Gut Catchment Board Area

To face p 1148

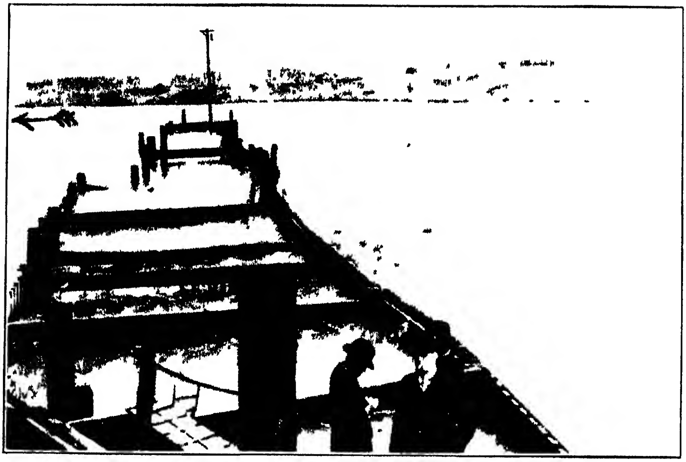


FIG. 2. Rother Outfall, August 19[illegible]4. Showing obstructing shingle spit and end of Eastern Pier. Looking seawards.

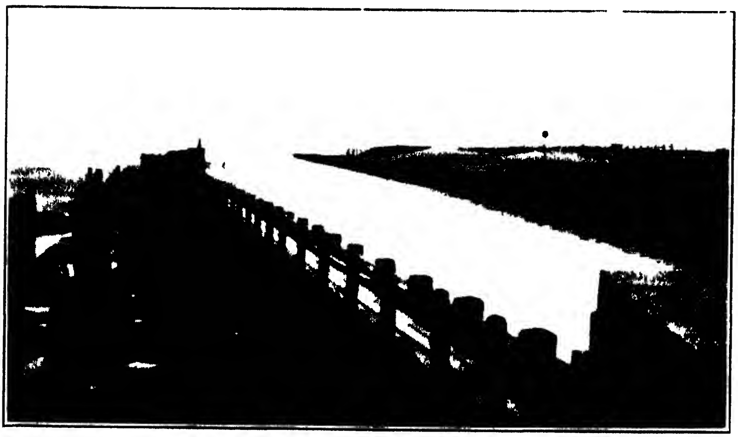
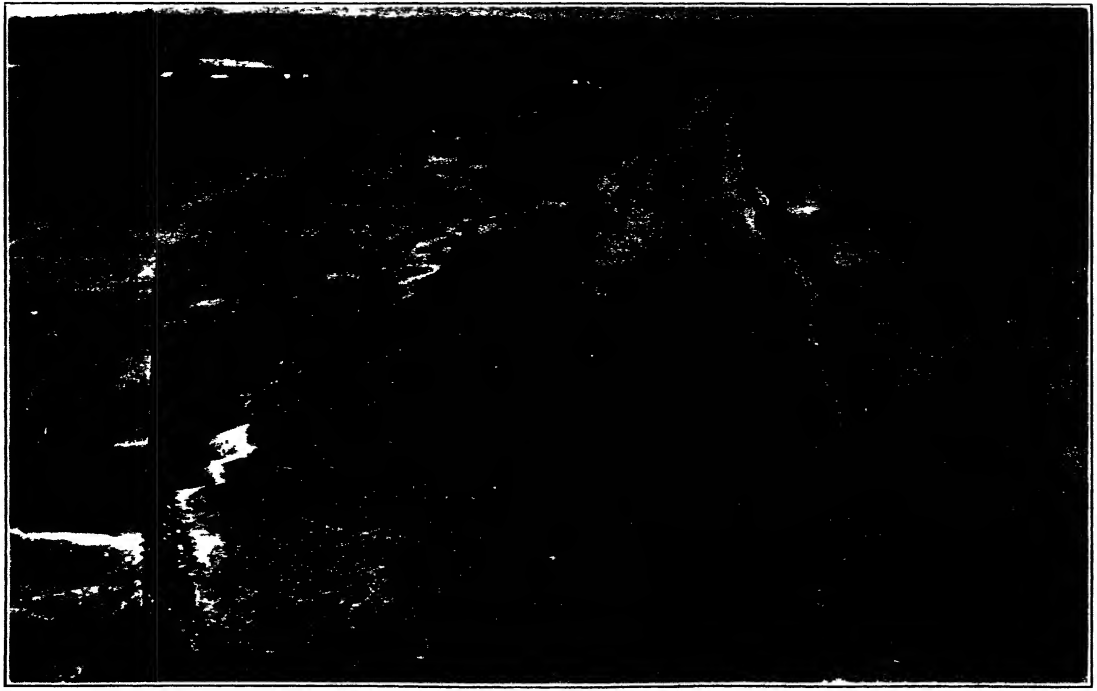


FIG. 3. Rother Outfall from same viewpoint in 1938.



Photograph by Aero Pictorial Ltd.

FIG. 4. Rother Outfall showing training works. July 1937

Fig. 5. Sea Defence works under construction 1934

them under Section 55 of the Land Drainage Act, 1930, whereby they may obtain Government assistance for schemes of improvement.

Sea-Defence Schemes. The shingle bank extending from Fairlight Cliffs to Rye Harbour had been subject to serious erosion for some years when, in November, 1930, a breach was formed at Dogs-Hill. Some attempts were made by the newly-constituted Catchment Board to close the breach by the use of faggotting and clay in bags, but this did not prove completely successful. Fortunately the breach was not in an extremely vulnerable position, but in 1933 it became imperative that the breach should be closed since further extension of the flooding would menace large areas. The accompanying diagram shows the area which lies below high-water mark of ordinary tides, and which might ultimately become inundated if the sea-defence works were neglected. Mr. E. Latham, M.Inst.C.E., was accordingly asked to prepare a scheme for the protection of the foreshore between Fairlight and Rye Harbour. His scheme was approved by the Board and submitted to the Minister for a grant under Section 55 of the Land Drainage Act. In view of the importance of the scheme, a grant of 62 per cent. was offered to and accepted by the Catchment Board.

Mr. Latham's scheme was estimated to cost £163,393, and the first work carried out was to close the breach, which was accomplished with the aid of a large quantity of chalk. The principal work carried out under the scheme was the construction of a barrier some 3½ miles long, together with a wave screen and numerous groynes. The barrier consists of two rows of piles spaced 12 ft. apart, supporting 9 × 3 in. planking and forming a box which is filled with beach. The top of the front of this barrier is at a level of 20 O.D. which is 7 ft. above the level of high water of ordinary spring tides. Where possible, lengths of existing breastwork were incorporated into the new work. In front of the barrier at an average distance of 50 ft. is the wave screen, which is constructed of 9 × 9-in. piles at 18-in. centres, leaving a 9-in. space between. The top of this wave screen is at a level of 13 O.D. Groynes were constructed, spaced generally at 300-ft. intervals, but at the western end of the work a number of old groynes were incorporated which were as much as 500-ft. apart. The length of the new groynes was generally 250 ft., while the old ones

varied from 250 ft. to 500 ft. It was found, however, that the spacing of these groynes allowed too much movement of shingle and a number of short groynes extending between the barrier and wave screen were constructed.

In addition to this main work of sea defence a number of other works were carried out to the entrance of Rye Harbour under the same scheme. These included an extension of the East Pier for a distance of some 200 ft., the extension of the inner western sheeting and the removal of a large quantity of shingle.

On the completion of this scheme, it was decided to carry out additional works estimated to cost £20,000. These works were approved for a similar grant, namely 62 per cent., and consisted principally of the extension eastward of the barrier and wave screen for a length of 1,400 ft., together with additional stub groynes between the wave screen and barrier. In addition, a number of long, low sand groynes were built.

Further works are now in hand at Rye Harbour, consisting of the construction of several heavy groynes to the west of the harbour. These are intended to relieve the load on the Western Groyne constructed under former schemes and to aid the accretion of the foreshore in front of the eastern end of the barrier. These further works, costing £6,500, rank for a similar grant to that made for the previous works.

In order to provide protection for the aforementioned works, bye-laws were made by the Board, and confirmed by the Minister in 1936, making it necessary for consent to be obtained before buildings are established within 50 ft. of the works and also containing restrictions regarding the removal of material.

Land Drainage Schemes. In 1935, improvements to the "main" river of the Board and to the outfall of the Jury's Gut, together with further improvements to the outfall of the river Rother were decided upon. A scheme was prepared and an application was made to the Minister for a grant towards the cost, estimated to be £125,000. The scheme was approved and a grant of 70 per cent. of the loan charges was made. Two supplementary schemes estimated to cost £28,000 and £10,500 were submitted in 1936 and 1938, and qualified for similar grants to that given in the first instance. Space does not permit of a detailed description of each of

the items of work included in the schemes, but the following brief notes will give an indication of the comprehensive manner in which the watercourses comprising the "main" river of the Catchment Area have been improved or are in the course of improvement.

The first work to be carried out was a timber extension of the Eastern Pier at Rye Harbour for a further 300 ft., so as to confine and train more efficiently the outfall of the river. Reference has already been made to extensions of this pier which were carried out, firstly, in 1924 under the Unemployment Relief Scheme and more recently under the sea-defence scheme. The eastern wall to which these extensions have been made was constructed many years ago and was built of dry sandstone rubble, which, in the course of time, has been softened by the ebb and flow of the tide. To strengthen this wall a reinforced concrete face was added by the process of cement gunning, and, on completion of this facing, the remaining interstices were filled in by pressure grouting with cement mortar.

In 1935, 1936 and 1937, as was anticipated, it was necessary to extend the high sheeting of the western groyne at Rye Harbour for distances of 100 ft. on each occasion in order to prevent the accretion of shingle from blocking the harbour mouth. As previously mentioned, it is anticipated that the groynes which are at present under construction under the sea-defence scheme will materially assist in relieving the western groyne.

Dredging of the tidal river Rother was commenced in April, 1936, at Ferry Steps, a point some ¾ mile from the mouth of the river, and proceeded upstream to Scots Float Sluice, the lower part being left temporarily to be dealt with later by means of a suction dredger. This dredging of the tidal river, which was done under contract, was carried out almost entirely by the use of scoops operated by traction engines working on the banks and was completed towards the end of 1937. Owing to the increased scour brought about by the improvement of the outfall and by the dredging described, it was found unnecessary to carry out a large proportion of the suction dredging which had been contemplated in the lower length of the river. The inner western sheeting was also reconstructed by the use of longer piles of a heavier section, and was carried some 4 ft. higher than it previously existed, to confine the river to a narrow channel for a greater time. In the course of

these works it was found possible to re-design the outfall from the ditch draining land behind the sea-defence works and known as the Davis Gut, so that the flow from the Gut was piped into the river Rother, thus removing the cause of a shoaling which had previously given trouble. A clay training-wall was built parallel to the sheeting to limit the area covered at high water and so prevent silt being drawn into the river from the adjoining saltings. These latter works were the subject of the first extension of the scheme.

At the present time an extensive programme of dredging is being carried out by direct labour on the watercourses comprising the " main " river of the Catchment Area. The work is being executed by dragline excavators, generally working from the banks, but, when conditions render it necessary, one of the machines is mounted on a pontoon. Lengths of the rivers Rother, Brede and Tillingham, the Rock Channel, the Union Channel, and the Five Waterings, White Kemp, and Jury's Gut Sewers are included in the programme, a total length of 28 miles, of which 15½ have been completed to date, involving the removal of some 500,000 cu. yd. of material. The spoil resulting from the work, after being allowed to dry out, is spread by means of tractor-drawn rotary scrapers. This spreading has resulted in the waiving of a considerable number of claims for compensation.

At Strand Quay on the river Tillingham, just above its junction with the river Brede, there exists the only quay authorized by the Board of Trade for the unloading of merchandise in the harbour. The movement of shipping at this quay caused considerable falling away of the mud bank on the opposite side of the river, resulting in the deposit of a considerable quantity of silt in the river bed. To prevent this, steel sheet piling has been driven on both sides of the river and has been surmounted with a reinforced-concrete coping. The piling extends for some 800 ft. on either side of the river, thus preventing interference with drainage by the berthing of ships.

Some 1,400 ft. of half-tide camp sheeting has been driven in order to stabilize the course of the Rock Channel, which takes the combined flow of the Brede and Tillingham to the Rother. Prior to the carrying out of this work, the scour in the channel, which is tidal, undercut the river banks and endangered the tidal flood banks. Dredging work, to which reference has already been made, is being carried out in this

channel. A further 1,800 ft. of sheeting will be constructed at the junction with the river Rother under one of the supplementary schemes.

At Union Sluice, where the main channels draining the Walland area meet the river Rother, and also at the main sluice on the Rother at Scots Float, camp sheeting has been driven to prevent scouring of the banks. New timber doors have been provided in the navigation pen at Scots Float, and extensive renovation of the masonry of the sluices has been carried out. It is intended to carry out training work both above and below the sluice during the present year.

An entirely new sluice has been provided at Potman's Heath Bridge, advantage being taken of the necessity for the reconstruction of the bridge to incorporate a sluice in the new structure. This sluice will serve the dual purpose of preventing flood water from the Rother valley from spreading into other parts of the area and of providing a means of retaining water during the dry summer periods, a necessity which the Board has always in mind.

In the upper reaches of the river, in common with so many of the rivers now under the jurisdiction of Catchment Boards, little work was carried out prior to the formation of the Board, and as a consequence these had become badly obstructed with fallen and overgrowing trees. Pioneer work is now being carried out on a length of 12½ miles between Bodiam Bridge and Turks Bridge.

The Jury's Gut outfall, which is the only outlet to the sea under the jurisdiction of the Board, apart, of course, from the river Rother itself, has been reconstructed at least twice during the last 100 years and has required extensive repairs on a number of occasions. The outfall flume has in recent years been badly underscoured. Work now in hand provides for protecting the sluice culvert by driving steel sheet piling on either side of it and for the provision of a reinforced-concrete trough extending seawards from the end of the culvert. The trough, which is, of course, intended to provide a clear run through the sand, is itself protected from under-scour by steel sheet piling, the top of which is incorporated in the concrete.

At the present time the main sluices at Scots Float form the only barrier to prevent tidal water from flooding large areas of lowland surrounding the river Rother. It is proposed to construct a second barrier some 2½ miles upstream of this on the river Rother for the dual purpose of preventing

the influx of salt water should Scots Float fail, and for the retention of an adequate supply of fresh water in the river during dry periods.

It is contemplated that the present schemes will be still further supplemented so as to provide for the dredging, where necessary, of all the remaining watercourses comprising the "main" river in the Catchment area. The internal drainage boards work in close co-operation with the Catchment Board, and in their turn are carrying out extensive improvement works to the smaller drains, some of which are being aided by grants under the Agriculture Act, 1937. There is no doubt that the works already carried out have resulted in great improvement to the drainage of the area, the benefits of which it is believed are fully appreciated by the local agriculturists.

The thanks of the Ministry are due to Mr. H. G. Finch, M.Inst.M.and Cy.E., Engineer to the Catchment Board, for his help in preparing these notes and also the accompanying diagram.

THE BUSINESS ORGANIZATION OF THE FARM

A Short Account of the Oxford Farming Conference

This subject was the general theme of the Farming Conference convened at Oxford from January 3 to 5 under the joint auspices of the School of Rural Economy and the Research Institutes in Agricultural Economics and Agricultural Engineering. The purpose of these annual conferences, of which the one held in January was the fourth, is to provide a forum for the discussion of important aspects of agriculture by practical farmers and research workers. This object was amply fulfilled on this occasion; the conference was well attended; the papers read were, without exception, excellent, and the discussion, which was maintained on a high level, manifested the interest which the proceedings aroused.

The following papers were read:—

THE ECONOMICS OF THE LABOUR PROBLEM:
Dr. K. A. H. Murray, Agricultural Economics Research Institute.

THE FARM LABOUR SUPPLY:
The Training of Young Farm Labour
Mr. J. A. S. Watson, Sibthorpian Professor of Rural Economy.
Mr. S. J. Farrant, Burcote, Oxon.

FARM AND LABOUR ORGANIZATION:
Farm Organization and the Productivity of Labour
Dr. R. McG. Carslaw, School of Agriculture, Cambridge.
Farm Organization in Practice
Mr. James Keith, Pitmedden, Udny, Aberdeen.
Major T. K. Jeans, Broadchalke, Salisbury.
Labour Organization in Practice
Mr. P. Webster Cory, Notgrove, Bourton-on-the-Water, Glos.
Mr. E. Lousley, Lockinge Estate Office, Ardington, Wantage.

AGRICULTURAL CREDIT:
Agricultural Credit Facilities
Mr. W. Gavin, C.B.E., West Hoathly, Sussex.
Farmers and Credit
Mr. R. H. Kemsley, F.S.I., 164 Bishopsgate, E.C.2.
Agricultural Credit in Denmark, New Zealand and the U.S.A.
Mr. Arthur Jones, Reader in Agricultural Economics, University of Manchester.

SOME POSSIBILITIES OF LAND IMPROVEMENT:
Grassland Improvement by Contract
Mr. Moses Griffith, Cahn Hill Improvement Scheme, Aberystwyth.
Arable Land Improvement in East Anglia
Mr. F. H. Garner, School of Agriculture, Cambridge.
Modern Drainage and Ditching Equipment
Mr. S. J. Wright and Mr. J. H. Blackaby, Institute for Research in Agricultural Engineering.

In considering the problems of agriculture at the present

time, when rapidly-changing conditions are forcing upon the farmers the necessity to take stock of their business, it is pertinent to ask to what extent the industry is itself capable of readjustment to meet the new situation. But this would not generally be regarded as a popular subject for discussion with audiences, many of whose members may be convinced that factors external to the industry have been responsible for the condition of agriculture and that the remedy lies in countering these factors from without. The organizers of the Oxford Farming Conference, however, decided to address this challenge to their audience, and the programme was drawn up " in the belief that the future well-being of agriculture will depend at least as much on the organization within the industry as on changes in official policy." As will be seen from the programme set out above, the conference gave most attention to problems of Labour Supply and Farm Organization, but questions of Agricultural Credit were also discussed, and interesting papers were read dealing with possibilities of land improvement.

Economics of the Labour Problem. It is a commonplace that the number of farm workers is declining, but it is perhaps not realized that the drop has been as much as 47 per cent. between 1871 and 1931, while the number of farmers in 1931 appears to be not very different from what it was in 1871. Debate continues as to the reason for this very substantial decline in the number of agricultural workers, but it is probably true to say that in the pre-War period (1871 to 1900) when agriculture was slowly adjusting itself to new conditions, the supply of agricultural labour at a wage level at all comparable with industry, was in excess of demand. This point is borne out by the low level of wages prevailing in this period. In more recent years the exodus from farms has very often been caused by other conditions, e.g., the attraction of better-paid jobs in semi-rural or urban occupations, and it is probable that the "labour saving " methods which have been introduced into agriculture within the past few years, have been adopted not only because of higher labour costs but also because the men were actually leaving the farms in substantial numbers.

From the farmer's point of view it is not difficult to appreciate the movements to reduce his labour bill. In times of adversity the farmer's position is much less manageable

than that of the industrialist. The latter may indeed stand off a few "hands," but he will probably safeguard himself mainly by the purchase of less raw material and by reduction of output. The farmer's organization is much more rigid; he is probably not able at once to curtail his production to fit the reduced demand, and, on many farms, problems of organization make it impracticable to dispense with labour as a temporary measure. This consideration has undoubtedly disposed many farmers to re-organize their farms with a view to economy in labour, and this tendency is re-enforced by the disparity between wages and prices as compared with pre-War years. In brief, a farmer in 1933 (when prices were almost at their lowest) had to sell twice as much beef as in 1914 to pay for the same quantity of labour, and even as regards milk he had to sell about two-thirds more than in 1914. While, therefore, there are substantial reasons why the farmer should seek to reduce his labour bill, it is also not difficult to see why the agricultural workers leave the farms. Apart from the fact that agricultural wages compare so unfavourably with industrial wages, the farm worker finds that the cost of living in respect of most purchased commodities is rather higher than in the towns. The one exception is rent, but the lower rent is more than offset by the almost total lack of conveniences which the average country cottage affords. In this matter the influence of the workers' womenfolk makes itself felt, and it is possibly a factor which has been largely forgotten. As important as this, however, is the lack of leisure, and, so far as the younger generation is concerned, the lack of reasonable opportunities for advancement. There appeared to be a fair measure of agreement that while these adverse conditions remain, there is little hope of keeping the young men on the land or of attracting recruits, and it was generally felt that while wages were an important consideration the other factors were even more important at the present juncture.

What remedy can be suggested to meet this situation? Does it lie in the direction of family farming or is the present unit of enterprise too small to give the most advantageous return? If the youths are leaving the countryside because of the lack of leisure, it would hardly seem that family farming can be looked on to provide a solution to present-day problems. But before concluding that larger enclosures are indicated, what can be said with regard to farm organization on existing lines?

Farm Organization. In this connexion the question naturally arises — how can our existing farms produce most economically? On this subject we were reminded that technical efficiency, with its greater output per man, though a most important factor, is not the whole story. A man may produce his goods with greater technical efficiency and yet fail to make a profit. Indeed, it is conceivable that by concentrating his attention exclusively on securing the maximum output per worker as, for instance, by a scheme of mechanization, a farmer might even reduce his aggregate profit because he has neglected to regard his farming *as a whole*. This is very largely accounted for by the fact that the fixed overhead costs are independent of output and form a very substantial proportion of total farm costs. In this context, therefore, we may say that the farmer's job is to organize his various resources—and not only his labour—to secure the maximum economic output from these overhead costs. Bearing in mind, therefore, the over-riding claims of "economic efficiency" as distinguished from a purely "technical efficiency" there are two directions along which farm output can be increased: (1) quantitatively—e.g., by raising the yields of crops or livestock, and (2) qualitatively—e.g., by substituting more valuable crops or stock for less. In some circumstances it will pay a farmer to follow one method, and in other circumstances the other: the test being whether the aggregate, as distinguished from the departmental profit is likely to be increased.

Following on an introduction, of which the above is a short résumé, the conference listened with very great interest to four papers by practical men. Two of these papers on the subject of *Farm Organization in Practice* will, it is hoped, be reproduced in the March issue of this JOURNAL. The other two papers dealt with *Labour Organization in Practice*. One paper describing the planning and organization of a large poultry farm which had clearly been carried to a pitch hardly attainable by most farmers situated on the generality of farms. The other described the method of organization employed on an estate of 10,000 acres in Hampshire; here again, it was felt that these were not "average conditions," and while the importance of a convenient layout could clearly be seen and appreciated, the question which obviously interested the members of the conference was "what is possible for the *average* farm," and to this question these papers did not

indicate any clear answer. Indeed, the question was asked "Is the small farm doomed?" Certainly not all classes of small farm; but a doubt was expressed as to whether in the circumstances of to-day the medium-sized arable farms would not require reorganization and possibly re-grouping.

One of the great advantages of the larger farms was clearly brought out, viz., that arrangements can more easily be made to give the workers their week-end leisure or its equivalent, which the conference seemed to think was one of the most potent causes why workers leave the farms. Several speakers emphasized the importance of having "interested" labour; piece work was found by some to afford the necessary stimulus; another suggestion was that if the men are required to keep records of their work and the time spent, it is an aid to keenness.

Training of the Farm Worker. The training of the farm worker was also discussed by the conference. It was pointed out that the educational facilities at farm institutes were only sufficient to deal with a small proportion of the workers' children, and that possibly the courses at these institutions aim at doing too much. A youth does not necessarily need to be trained for all the jobs on a farm; it would probably be better if his course were made more practical and limited to the class of work on which he is engaged. The main suggestion thrown out on this subject, therefore, was that if courses were shortened say to three weeks' duration, the purpose of a youth's "vocational" training might be better served, and a very much larger number of students could be dealt with. The training of town-bred youths for farm work at certain special training centres was also described, and in the subsequent discussion a system of apprenticeship, under which town-bred youths might be "articled" to selected farmers, was advocated by some speakers.

Agricultural Credit. The farmers' problems in relation to credit facilities were dealt with in three papers read to the conference. It will not be possible here to deal at length with this subject. It may, however, be of interest to record that the point of view for which a good deal of support appeared to be forthcoming was contained in the statement that it is not so much lack of capital as inadequate prices which are mainly responsible for farmers' difficulties, and that given some-

amelioration of this condition of things there would be ample capital available for the industry.

Land Improvement. At its closing sessions the conference heard interesting accounts of the grassland improvement scheme which has been carried out at Cahn Hill, Aberystwyth, in which very rough hill country has been ploughed and seeded and now carries very good grass. The experiment has aroused so much local interest that many farmers in the neighbourhood have arranged to have their land ploughed and, in some instances, seeded under a contract scheme. A descriptive account was also given of the large-scale experimental work in reclaiming tracts of very light land in East Anglia.

The conference concluded with a paper on modern drainage and ditching equipment.

Readers who are interested in these Oxford Farming Conferences and would like to have particulars of them in future should communicate with the Conference Secretary (Mr. S. J. Wright), 10, Parks Road, Oxford.

FEBRUARY ON THE FARM

R. W. Wheldon,
King's College, Newcastle-upon-Tyne

It is probable that in no season of the year is more skill required in connexion with cultivations than in the month of February. The neglect of some operation may result in serious loss, while the carrying out of other work when conditions are unsuitable may have similar results. As a rule, the conditions of the soil are such that even slight changes in weather conditions affect cultural work, and the problem needs daily consideration.

While the first essential is the pushing forward with seasonal work, attention should always be given to useful alternatives for the full employment of available labour when this work is interrupted.

On grass farms, attention is usually given to the mechanical treatment of meadows and pastures. Where there is a large amount of matted turf, efficient harrowing by suitable implements may do much to remove it. Postponement of this work may entail a reduction of the effectiveness of the implements through the drier soil conditions, or the destruction and checking of new growth. The decayed material should be brought to the surface, gathered and, if possible, burned. Any dry spell might be utilized for this purpose. Where there is a large amount of ungrazed or ungrazable material, it may be possible to remove this by burning on the ground. On the better pastures and meadows, any ungrazed grass that remains should be eaten off in good time to allow for new growth. Owing to the mild conditions that allowed stock to be kept out-of-doors until early December, grazing has been well carried out on most farms, but on those where stock were indoors there is a considerable amount of roughage on the ground. Careful management is necessary to obtain the most favourable growth of spring grass, which is an important crop to both the dairy farmer and the sheep farmer in these days of intensive production. Excessive treading of bare ground during wet weather may result in poor soil conditions and reduced growth during spring and summer, while failure to remove decaying material will also limit growth.

In districts where the spring application of nitrogenous

manures, in order to obtain an early bite, has proved successful, the first applications are likely to be made during the month. In later and exposed situations, the results from these nitrogenous applications do not appear to have been so successful as in earlier or more sheltered situations.

Where farmyard manure is to be applied for the meadow hay crop, it is desirable that it should be got on and evenly spread as soon as possible.

Fertility. It has been asserted that the fertility of the land of this country is now lower than it was before the Great War. Whether this is true or not, the fact remains that agriculture is most important to the nation, and a prosperous agriculture cannot be carried on under conditions of low soil fertility. It is always easier to maintain fertility than to restore lost fertility. Low fertility brings in its train many troubles.

The force of economic circumstances in this country has resulted in large numbers of farmers changing their farming system, and there has been an increase in those who produce wheat and milk, both of which tend to have an exhaustive effect on the soil. Wheat cannot be grown successfully over a number of years under conditions of low fertility. While it is true that in 1938 many satisfactory crops of wheat were harvested on land which could only be regarded as being in low condition, in less favourable seasons the advantage of high fertility is most apparent.

The wide range of fertilizers helps the farmer to-day to compensate for shortage of farmyard manure, but these give the best results only if wisely used. Advice by the Agricultural Organizer should be sought if the farmer is in any doubt as to the most suitable fertilizers for his particular set of conditions.

It is felt that the dairy farmer sometimes tends to depend on purchased feeding stuffs rather than on home-produced foods. It is always desirable that the greatest possible use should be made of the farm in producing food for the dairy cow. The quantities of concentrates fed to dairy stock are often regarded by farmers as an excellent means of maintaining fertility. While it is quite true that the residual value of these concentrated foods fed to dairy stock is considerable, there is a danger of over-estimating their value. Only where the farmyard manure is carefully stored and the dung and urine conserved is the full benefit obtained, and on by-

far the majority of farms there is actually a considerable amount of loss. The liquid manure tank on many farms is seldom used and the large amounts of water now necessarily used in the cowsheds contribute to the loss incurred. To avoid this serious dilution two sets of drains are sometimes used, so that, when the cowsheds are being washed down, the water does not go to the liquid manure tank.

As a rule, the chief residual value from these purchased foodstuffs lies in the nitrogen content, and the greatest loss from the farm is probably phosphates and lime. It is, therefore, important to make sure that there is a sufficient supply of both phosphate and lime in the soil. If these are deficient, the best results are not likely to be obtained. The whole trend of modern research reveals the need for and value of balanced manuring.

Cereal Seeds. Farm seed catalogues offering a wide range of varieties of all classes of farm seeds are now in the hands of farmers. The selection of a variety of cereal suited to the particular conditions of the farm is most important, and it should be borne in mind that even the best variety does not do equally well under all conditions. Farmers should be conversant with the excellent work done in connexion with the testing carried out in different districts by the National Institute of Agricultural Botany. The results give a guide as to the general usefulness and adaptability of the varieties tested. While the number of varieties tested is necessarily limited, the list includes many suitable for general cropping and which would serve as a basis for comparison with other varieties on the farm. The results of variety trials carried out at any centre invariably indicate that there is a wide range of yield obtained from the different varieties employed.

In addition to the right variety, a good stock of seed should be chosen and arrangements made to dress it with a suitable seed dressing.

Cattle. Important sales of stock bulls take place during the month, and many herds find new leaders.

The purchase of a new stock bull is a matter for serious consideration with many breeders and it is right that it should be so. It is often said that, from the breeding point of view, the bull is half the herd. Many a bull has brought fame to

his owner, while others have brought disaster. With the leading breeders the characteristics of different herds are well known, and a personal perusal of the sale catalogue and pedigrees gives information as to the animals which may be suitable, as the individual merit of most of the parents is well known. No breeder with a valuable herd would be content to make his choice of herd sire on the type and quality of the individual alone; he would need to be assured that the ancestors of the animal had desirable characters, or, in other words, it had a good pedigree. Animals whose ancestors have desirable characters are more likely to produce offspring with these qualities.

Animals offered at the sales represent breeding and nurture. The calf is born with certain potentialities derived from its sire and dam. Whether these characteristics are developed to the greatest advantage depends in a large measure on how the animal is reared and brought to maturity. It is always well to bear in mind that an animal can only hand on to its offspring characteristics derived from its own parents, and it is not able to hand on any of the characteristics which may be due to feeding and management. While good management demonstrates what possibilities there may be in the animal, these may have been developed under specially favourable conditions. It is, therefore, desirable to know how far these characteristics are seen in the ancestors which may have been kept under more normal conditions, as the bulk of the progeny of the animal have to live under farm conditions.

Everything points to the fact that it is desirable to know something about the characteristics of the ancestors of our breeding animals as well as their own individual merit. The difference in the value of the progeny of the good and medium sire represents a considerable amount of money, and in a breeding herd an indifferent sire may greatly reduce the value of the herd or, alternatively, hold up improvement.

With beef cattle it takes about two years before the real value of a sire can be judged, and with dairy stock even longer. In many valuable herds it is the practice to try out the bull on a few cattle and only use him extensively in the herd if his value as a breeder has been proved. In small herds this may not always be possible and good breeding animals sometimes find their way to the butcher at a young age when they could be very usefully employed in other herds. The value of a

proved good breeding animal, male or female, cannot be over-estimated and such should be retained as long as possible.

This country enjoys a great reputation for its live stock, and undoubtedly we have a large number of very excellent animals. On the other hand, a visit to our markets reveals the fact that we have a considerable percentage of animals which can only be regarded as inferior and not likely to give an economic return to the farmer. It is fully recognized that the improvement of the best is very difficult, but much can be done to raise the standard of the poorer animals in our herds. Under the Ministry's Livestock Improvement Scheme premiums are awarded to approved sires, and in localities where advantage has been taken of this the improvement in the stock has been most marked.

It need scarcely be emphasized that good dams are also important if the best results are to be obtained, and it is desirable that the best breeding animals should be retained in the breeding districts.

Much is being done to increase efficiency in crop production, and a large proportion of the crops we grow has to be converted into meat or milk before it is saleable. The efficiency of the animal in performing this work greatly affects the return obtained.

FOOT-AND-MOUTH DISEASE

Twenty-six outbreaks of foot-and-mouth disease were confirmed during the period December 21 to January 20 inclusive. Two of the outbreaks, namely, those at Tring, Herts, on December 29, and at Mentmore, Bucks, on December 30, were in the Infected Area which already existed around Rowsham, Bucks.

The imposition of Infected Area restrictions on areas each of approximately 15 miles radius around the various infected farms was rendered necessary by outbreaks of disease at Pakefield, Suffolk, on December 22; at Reydon, Suffolk, on December 23; at Lisvane, Glamorgan, on December 23; at Llanvihangel-Gobion, Monmouth, on December 30; at Mattishall, Norfolk, on January 2; at Lydd and Benzett, Kent, on January 4; at Leckford, Hants, on January 6; at Burham, Kent, on January 7; at Marlow, Bucks, on January 12; at Peaslake, Surrey, on January 18; and at Steeple Claydon, Bucks, on January 18. There were five further outbreaks in the area around Lisvane, Glamorgan, the latest being at Llanishen on January 2, five additional outbreaks in the area around Lydd and Benzett, Kent, the latest being at Harbledown on January 19, and one further outbreak in the area around Blunsdon St. Andrew on January 10.

The areas around Rowsham, Bucks, Pakefield and Reydon, Suffolk, Llanvihangel-Gobion, Monmouth, and Lisvane, Glamorgan, have been released from restrictions.

MISCELLANEA

Poultry Farming in Relation to the Agricultural Wages (Regulation) Act, 1924

In the period which has elapsed since the passing of the Agricultural Wages (Regulation) Act in 1924, a doubt has sometimes arisen as to whether certain classes of workers were or were not covered by the provisions of the Act. The purpose of the Act is to provide for the regulation of wages of workers in *agriculture*, and agriculture is defined in the Act as " including dairy-farming and the use of land as grazing, meadow, or pasture land or orchard or osier land or woodland or for market gardens or nursery grounds." No specific mention is made in this definition of poultry farming, and although in the administration of the Act the Ministry has consistently taken the view that workers engaged in connexion with poultry came within the scope of the Act, the point has sometimes been contested. In this connexion it is of particular interest to record that the Ministry recently successfully appealed against the decision of the Wetherby (West Riding of Yorkshire) Magistrates dismissing the case of an employer who had been charged with failing to pay wages at not less than the minimum rates fixed under the Act, to a worker employed on a holding on which the business of poultry farming was carried on. In the course of his judgment the Lord Chief Justice said:—

> It is found as a fact that the respondents occupied a holding known as Moorside Poultry Farm, East Keswick, and there carried on what is called the business of poultry farming. The extent of the holding, we are told, was about 7½ acres of grass land, of which about 4 acres were not in use at the time of the alleged offence. The stock, it is said, varied according to the season, but at the busy season there were 2,500 young chickens on the holding. No other stock except the poultry was kept, nor any other business carried on upon the holding. The question, in those circumstances, was whether it was true to say that the man whose wages were being referred to was a person employed in agriculture within the meaning of the Statute.
>
> The Case finds as a fact that at all material times the duties of this

man were the duties of a general worker on a poultry farm and, in particular, he was employed in care and attention to the poultry; he prepared their food, fed and watered them, cleaned out the poultry houses and runs, and repaired them. He also attended to the incubators and killed and prepared poultry for sale for domestic consumption.

Referring to the definition of "agriculture" set out above in this note, His Lordship continued:—

That definition obviously does not purport to be an exhaustive definition. It is not even a definition by simple enumeration; it seems rather to be a definition partly, at any rate, by means of specific illustrations or examples. The question is, I think, whether the meaning of the Legislature is made sufficiently plain in that defining section to make it reasonably clear that, for the purposes of this Act though it may not read exhaustively for all purposes, poultry farming comes under the denomination of agriculture.

After alluding to two Scottish cases, viz:—Lean *v.* Inland Revenue, 1926, and Assessor for Lanarkshire *v.* Smith, 1933, the Lord Chief Justice said that it had been contended before the Court

"that for the purposes, at any rate, of this legislation 'agriculture' includes any use of land in connection with breeding or keeping of any animal ordinarily found on a farm. I think there is much to be said for that definition, and I certainly think, regard being had to the authorities which have been cited to us, that so far as poultry farming is concerned, the definition contained in the Act of 1924 is wide enough to include it under the head of 'agriculture.'"

Mr. Justice Charles and Mr. Justice Macnaghten concurred, and the case was returned to the Magistrates with the direction to convict and make the necessary Order.

Supplies and Prices of Maincrop Potatoes in the 1937-38 Season

SUPPLIES. The total supply of maincrop potatoes on the market in Great Britain during the 1937-38 season was slightly higher than in 1936-37, and about the same as in 1935-36. The acreage under potatoes in Great Britain in 1937 showed no change on the previous year, but the estimated yield per acre was, with the exception of 1934, the highest recorded since 1929, and was above the ten-year average for the period 1927-36. The total production, at 4,048 thousand tons, was, however, still below the ten-year average for the period 1927-36.

The following table shows, for each of the past seven seasons, the estimated total production of potatoes in Great Britain, and the maincrop supplies available after deducting first earlies, exports and seed, and adding shipments to Great

Britain from Northern Ireland, and imports into the United Kingdom:—

	Total Production in Great Britain (000 *tons*)	*Approximate Net Maincrop Supplies* * (000 *tons*)
1931–32	3,154	3,270
1932–33	4,450	3,740
1933–34	4,555	3,750
1934–35	4,464	3,740
1935–36	3,765	3,305
1936–37	3,804	3,205
1937–38	4,048	3,320

* Including wastage and livestock feed.

In May, 1938, the Potato Marketing Board announced certain relaxations of the riddle regulations, and provision was also made for the sale of "seconds," i.e., potatoes below the ordinary minimum standard size, for human consumption.

REGULATION OF IMPORTS. Imports of potatoes into the United Kingdom were controlled as hitherto, under the Potato (Import Regulation) Order, 1934. The increase in home production and the shortage of supplies available for export on the Continent resulted in imports again falling appreciably short of the maximum quantity permitted under the Order, i.e., 32,000 tons.

Over the whole season from September, 1937, to June, 1938, inclusive, imports totalled rather more than 27,000 tons, as compared with over 126,000 tons during the 1936-37 season.

The following table shows, month by month, the imports of maincrop potatoes into the United Kingdom during the 1937-38 season, and comparable figures for the two preceding seasons:—

	1935–36 (*tons*)	1936–37 (*tons*)	1937–38* (*tons*)
September	100	100	200
October	800	1,500	1,000
November	1,000	8,900	1,900
December	5,600	23,300	2,700
January	21,500	14,100	2,800
February	16,500	9,200	1,700
March	18,900	12,800	2,600
April	24,000	28,600	1,800
May	26,400	17,400	8,600
June	7,100	10,400	3,900
	121,900	126,300	27,200

* Subject to revision.

Shipments to Great Britain from Northern Ireland during the 12 months September, 1937, to August, 1938, amounted to 186,700 tons as against 206,000 tons in 1936–37, and 242,000 tons in 1935–36.

PRICES. Growers' and wholesale prices throughout the 1937-38 season were appreciably lower than those of the preceding season and compared unfavourably with the 1935-36 season, except at the beginning and the end of the period. Prices remained fairly stable, below the 1936-37 level, until May, when with increasing shortage of supplies, a sharp rise occurred; this was followed by the usual seasonal fall in growers' prices in June.

The following table shows the monthly index numbers (base, 1927-29 = 100) of prices of maincrop potatoes during the past 3 seasons:—

Month	1935–36	1936–37	1937–38
September	85	92	84
October	84	122	85
November	89	131	86
December	113	139	87
January	128	133	88
February	122	130	85
March	123	137	84
April	126	158	86
May	127	156	139
June	113	149	126
MEAN	111	135	95

Retail prices throughout the season were at a lower level than in either of the two preceding seasons, but were higher than in 1934-35. The averages of the monthly retail prices indices (base, July, 1914) from September to May in the four seasons, 1934-35, 1935-36, 1936-37, and 1937-38, were 124, 148, 149 and 131 respectively.

Wart Disease Immunity Trials, 1939

The Ministry will continue during the coming season to test, at the Potato Testing Station of the National Institute of Agricultural Botany at Ormskirk, Potatoes and Potato Seedlings as to their immunity from or susceptibility to Wart Disease on conditions similar to those specified in recent years. (See this JOURNAL, January, 1937, pp. 1003-1005.)

The entry form (No. 345 H.D.), obtainable from the Ministry, should be filled up and returned to the Potato Testing Station, Ormskirk, Lancs, *with the requisite fees.* Samples must be sent to that station *as early as possible, but in any case not later than March* 4.

Marketing Notes

Livestock Industry Act, 1937: *Cattle Fund.* For the nine months, April-December, 1938, payments in respect of fat-cattle subsidy amounted to £3,115,375 as compared with £2,878,535 and £2,946,416 for the corresponding periods of 1937 and 1936 respectively. The number of beasts concerned was 1,124,900, as against 1,189,528 in 1937 and 1,259,414 in 1936, so that the average rate of subsidy, £2 15*s*. 5*d*. per animal, was somewhat higher than in either of the earlier periods. This high average is the outcome of the revised scheme, which came into force on August 1, 1937, under which subsidy is payable at varying rates for "ordinary" and "quality" standards, the highest rate being 7*s*. 6*d*. per cwt. for home-bred animals of "quality" standard.

Markets and Fairs (Weighing of Cattle) Acts, 1887 *to* 1926. Under an Order made by the Minister of Agriculture and Fisheries on December 19, certain functions exercised by the Ministry in relation to markets were delegated on January 1, 1939, to the Livestock Commission.

These functions, which are specified in Section 21 of the Livestock Industry Act, under which the Orders were made, are those in the exercise of which it rests with the Minister, (*a*) to be satisfied that sufficient and suitable accommodation for weighing cattle, sheep and pigs has been provided by a Market Authority as required by the Markets and Fairs (Weighing of Cattle) Acts, 1887 to 1926, in cases where exemption has not been granted, and (*b*) to grant under these Acts any exemptions of the following character:—

(1) to Market Authorities from the requirement to provide suitable facilities for weighing cattle, sheep and pigs at markets and fairs,
(2) to Auctioneers from the requirement not to sell cattle, sheep or pigs at any mart unless suitable weighing facilities are provided at the mart, and
(3) to Auctioneers from the requirement that cattle fit for immediate slaughter shall not be offered for sale by an auctioneer in any market, fair or mart in or near which a weighing machine is provided, unless the cattle have been weighed on the machine and their weight disclosed to intending purchasers at the time of the offer for sale.

As from January 1, 1939, livestock market authorities and auctioneers desiring exemption or renewal of exemption from the obligations imposed by the Acts should apply to the Livestock Commission, 1, Sanctuary Buildings, Great Smith Street, London, S.W.1.

Potato Marketing Scheme: ***Area Under Potatoes in Great Britain.*** This booklet which the Potato Marketing Board has just issued for the third successive year contains useful statistical information. The introduction embodies a comparison of the official statistics for Great Britain with those of the Board and explains in what respects they are not identical. The greater part of the booklet is devoted to data of acreages, by counties, of each variety planted by registered producers in the years 1936, 1937 and 1938. In addition, there are tables showing (*a*) the order of importance of counties from the point of view of potato growing, and (*b*) the density of potato cultivation. Maps by areas are again a feature of the booklet, which is entitled *The Area Under Potatoes in Great Britain*—Miscellaneous Publications, No. 6, and is obtainable from the Board, price 6*d*., post free.

National Mark Cheese Schemes. Following a recommendation of the National Mark Cheese Trade Committee, the Minister has made revised regulations for National Mark Caerphilly Cheese so as to provide for two grades, namely, "Extra Selected" and "Standard," in place of the "Selected" grade hitherto prescribed.

The revised regulations—the Agricultural Produce (Grading and Marking) (Caerphilly Cheese) Regulations, 1939, which came into operation on January 11, supersede the Agricultural Produce (Grading and Marking) (Caerphilly Cheese) Regulations, 1935, and prescribe the following statutory definitions of quality for Caerphilly cheese:—

"EXTRA SELECTED" GRADE.

Minimum age at time of grading: Four days.
Flavour: Clean and mild.
Body and texture: Body: firm but neither hard nor spongy; free from gas holes; texture: close, smooth and short.
Appearance: Rind intact, good shape and finish, free from dark stain or mould, free from sliminess.
Colour: White, and of uniform shade throughout.
General Requirements: Pressed, made from full cream cows' milk produced in England or Wales, and containing a minimum of 45 per cent. butter fat in the moisture free substance.

"STANDARD" GRADE.

Minimum age at time of grading: Four days.
Flavour: Clean, not over acid.
Body and texture: Body: firm but neither hard nor spongy; free from gas holes; texture: flaky and short without excessive looseness.
Appearance: Rind intact, free from dark stain or sliminess.
Colour: White or creamy and of uniform shade throughout.
General Requirements: As for "Extra Selected" grade.

National Mark Publicity. BRITISH INDUSTRIES FAIR. Arrangements are being made for staging an exhibit of National Mark products at the British Industries Fair, which is to be held at Earl's Court from February 20–March 3. The display will include canned, bottled and fresh fruit and vegetables, fruit-juice products, honey, cider and perry, eggs, wheat flakes, cheese and flour. Samples of various National Mark products, and a range of the Department's publications, will be on sale at the Ministry's stand.

NATIONAL MARK "WEEKS." Arrangements are being made to hold National Mark "Weeks" at Leeds and Warrington during the periods March 23–April 1 and April 19–28 respectively.

Leeds is the largest centre yet selected for these exhibitions and every effort is being made to make the campaign worthy of the occasion. There will be cookery competitions for local housewives, shop-window display competitions for retailers with a separate class for butchers, and a poster-ballot competition. Three cookery demonstrations will be held daily at the Albert Hall, whilst films will be shown periodically in the demonstration theatre. In addition to an egg-grading demonstration, a cheese-making demonstration will be staged. A representative display of National Mark produce will be shown in the Hall and samples of the various products will be on sale.

APPOINTMENTS

COUNTY AGRICULTURAL EDUCATION STAFF : ENGLAND

Gloucestershire : Mr. P. A. H. Nock, N.D.P., has been appointed Assistant Instructor in Poultry-keeping *vice* Mr. F. J. Brooker, N.D.P.

Hampshire : Mr. J. C. M. Bearder, N.D.D., has been appointed Assistant County Dairy Officer *vice* Mr. W. P. Strang, N.D.A., N.D.D.
Mr. W. C. Ibbett, N.D.H., has been appointed Assistant Instructor in Horticulture.

Lancashire : Mr. F. J. Brooker, N.D.P., has been appointed Assistant Instructor in Poultry-keeping *vice* Mr. H. Temperton, B.Sc., N.D.A., N.D.P.

Norfolk : Mr. R. W. Kemp, N.D.H., has been appointed Horticultural Advisory Officer *vice* Mr. H. Taylor, N.D.H.

Somerset : Miss D. L. G. Connett, N.D.D., has been appointed Assistant Instructress in Dairying.
Miss D. V. S. Lamb, N.D.D., has been appointed Itinerant Instructress in Dairying.
Mr. R. P. Feltwell, N.D.P., has been appointed Assistant Instructor in Poultry-keeping *vice* Mr. F. R. Wallbutton.

Worcestershire : Mr. L. F. Clift, N.D.H., has been appointed Instructor in Horticulture *vice* Mr. E. W. Hobbis, N.D.H.

WALES

Anglesey : Miss K. Lloyd, N.D.D., has been appointed Instructress in Dairying and Poultry-keeping *vice* Miss J. Jones, N.D.D., resigned.

PRICES OF ARTIFICIAL MANURES

Description	Average prices per ton (2,240 lb.) during week ended Jan. 11				
	Bristol	Hull	L'pool	London	Costs per Unit ¶
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½%) .. *	8 0c	8 0c	8 0c	8 0c	10 4
,, ,, Granulated (N. 16%) *	8 0c	8 0c	8 0c	8 0c	10 0
,, ,, Lime (N. 13%) .. *	7 7e	7 7e	7 7e	7 7e	11 4
Nitro-Chalk (N. 15½%) .. *	7 10c	7 10c	7 10c	7 10c	9 9
Sulphate of Ammonia :—					
Neutral (N. 20·6%) .. .. *	7 11c	7 11c	7 11c	7 11c	7 4
Calcium Cyanamide (N. 20·6%) *	7 15d	7 15d	7 15d	7 15d	7 6
Kainite (Pot. 14%) .. .. §	2 18	2 15	2 15	2 15	3 11
Potash Salts (Pot. 30%) .. §	5 4	5 1	5 0	5 1	3 5
,, ,, (Pot. 20%) .. §	3 15	3 12	3 12	3 12	3 7
Muriate of Potash (Pot. 50%) §	8 10	8 8	8 5	8 8	3 4
Sulphate ,, ,, (Pot. 48%) §	10 2	10 0	9 17	10 0	4 2
Basic Slag (P.A. 15¾%) .. §	2 12b	2 5b	—	2 10b	3 2
,, ,, (P.A. 14%) .. .. §	2 8b	2 0b	2 0b	2 6b	3 3
Grd. Rock Phosphate (P.A. 26–27½%) .. .. .. §	3 5a	3 0a	2 15a	2 10a	1 10
Superphosphate (S.P.A. 16%) §	3 6	—	3 2f	2 19g	3 9
,, (S.P.A. 13¾%) §	—	—	2 19f	2 16g	4 1
Bone Meal (N. 3¾%, P.A. 20½%) §	—	7 5	6 17h	6 12	—
Steamed Bone Flour (N. ¾%, P.A. 27½–29½%) .. .. §	4 12i	4 15	4 15h	4 10	—

Abbreviations: N. = Nitrogen; P.A. = Phosphoric Acid; S.P.A. = Soluble Phosphoric Acid; Pot. = Potash.

* Prices are for not less than 6-ton lots at purchaser's nearest railway station, unless otherwise stated. Unit values are calculated on carriage-paid prices.

§ Prices are for not less than 2-ton lots, nett cash for prompt delivery, f.o.r., in town named, unless otherwise stated. Unit values are calculated on f.o.r. prices.

a Prices for 4-ton lots f.o.r. Fineness 85% through standard sieve.

b Prices for 6-ton lots. Prices at Bristol are f.o.r. Bridgwater; at Hull and Liverpool f.o.r. neighbouring works and at London f.o.r. at depots in London districts. Fineness 80% through standard sieve.

c For lots of 4 tons and under 6 tons the price is 1*s*. per ton extra, for lots of 2 tons and under 4 tons, 5*s*. per ton extra, for lots of 1 ton and under 2 tons, 10*s*. extra and for lots of 2 cwt. and under 1 ton, 20*s*. extra.

d Delivered in 5-ton lots at purchaser's nearest railway station. For lots of 2 tons and under 5 tons the price is 5*s*. per ton extra, for lots of 1 ton and under 2 tons, 10*s*. per ton extra and for lots of 4 cwt. and under 1 ton, 20*s*. extra.

e For lots of 4 tons and under 6 tons the price is 1*s*. per ton extra, for lots of 2 tons and under 4 tons 5*s*. per ton extra, for lots of 1 ton and under 2 tons 7*s*. 6*d*. per ton extra, and for lots of under 1 ton 20*s*. extra.

f Prices shown are f.o.r. Widnes.

g Prices shown are ex works London; f.o.r. southern rails, 1*s*. 3*d*. extra.

h Prices shown are f.o.r. Appley Bridge.

i Price shown is f.o.r. Newport, Mon.

¶ *These are calculated by regarding a ton as comprising* 100 "*units*" (*equal parts of* 22·4 *lb.*) *so that a fertilizer, for example, with* 16 *per cent. nitrogen contains* 16 *such* "*units*" *in a ton. Then, if the price per ton of such a fertilizer be divided by the percentage figure, the deduced cost is that of a* "*unit*" *of that agent. Those in the table above are based on London prices.* (*For further explanation, see Advisory Leaflet, No.* 146," *The Valuation of Artificial Manures,*" *obtainable from the Ministry, free of charge.*)

PRICES OF FEEDING STUFFS

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Wheat, British ..	4 10	0 9	4 1	72	1 1	0·58	9·6
Barley, British Feeding	6 0	0 8	5 12	71	1 7	0·85	6·2
„ Canadian, No. 3 Western	6 17	0 8	6 9	71	1 10	0·98	6·2
„ Persian ..	6 3*	0 8	5 15	71	1 7	0·85	6·2
„ Russian ..	7 3	0 8	6 15	71	1 11	1·03	6·2
Oats, English, white ..	6 10	0 9	6 1	60	2 0	1·07	7·6
„ „ black and grey	6 7	0 9	5 18	60	2 0	1·07	7·6
„ Scotch, white ..	7 10*	0 9	7 1	60	2 4	1·25	7·6
„ Canadian—							
„ No. 2 Western	6 17*	0 9	6 8	60	2 2	1·16	7·6
„ No. 3 Western	6 8§	0 9	5 19	60	2 0	1·07	7·6
„ Mixed feed ..	5 15	0 9	5 6	60	1 9	0·94	7·6
„ No. 1 Feed ..	6 8†	0 9	5 19	60	2 0	1·07	7·6
„ No. 2 Feed ..	6 15	0 9	6 6	60	2 1	1·12	7·6
Maize, American ..	6 17	0 7	6 10	78	1 8	0·89	7·6
„ Argentine ..	6 18	0 7	6 11	78	1 8	0·89	7·6
Beans, English, Winter	6 0§	0 18	5 2	66	1 7	0·85	19·7
Peas, English, blue ..	9 0§	0 15	8 5	69	2 5	1·29	18·1
„ Japanese ..	21 10†	0 15	20 15	69	6 0	3·21	18·1
Dari	8 0†	0 8	7 12	74	2 1	1·12	7·2
Milling Offals :—							
Bran, British ..	6 0	0 16	5 4	43	2 5	1·29	9·9
„ Broad ..	6 10	0 16	5 14	43	2 8	1·43	10·0
Middlings, fine, imported	5 15	0 13	5 2	69	1 6	0·80	12·1
Weatings‡	5 12	0 15	4 17	56	1 9	0·94	10·7
„ Superfine‡	6 0	0 13	5 7	69	1 7	0·85	12·1
Pollards, imported ..	5 7	0 15	4 12	50	1 10	0·98	11·0
Meal, barley	7 15	0 8	7 7	71	2 1	1·12	6·2
„ „ grade II	7 2	0 8	6 14	71	1 11	1·03	6·2
„ maize	7 5	0 7	6 18	78	1 9	0·94	7·6
„ „ germ ..	6 17	0 11	6 6	84	1 6	0·80	10·3
„ locust bean ..	7 10	0 6	7 4	71	2 0	1·07	3·6
„ bean	9 15	0 18	8 17	66	2 8	1·43	19·7
„ white-fish ..	15 12	2 5	13 7	59	4 6	2·41	53·0
„ Soya-bean (extracted)‡	8 10	1 11	6 19	64	2 2	1·16	38·3
Maize, cooked, flaked	7 17	0 7	7 10	84	1 9	0·94	9·2
„ gluten feed ..	6 15	0 13	6 2	76	1 7	0·85	19·2
Linseed cake—							
English, 12% oil ..	9 15	1 1	8 14	74	2 4	1·25	24·6
„ 9% „ ..	9 2	1 1	8 1	74	2 2	1·16	24·6
„ 8% „ ..	8 17	1 1	7 16	74	2 1	1·12	24·6
Cottonseed cake, English, Egyptian seed, 4½% oil ..	6 7	0 19	5 8	42	2 7	1·38	17·3

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Cottonseed cake, Egyptian, 4½% oil ..	5 17	0 19	4 18	42	2 4	1·25	17·3
Cottonseed cake, decorticated, 7-8% oil	7 10†	1 9	6 1	68	1 9	0·94	34·7
Cottonseed meal, decorticated, 7-8% oil	8 5†	1 9	6 16	70	1 11	1·03	36·8
Coconut cake, 5-6% oil	7 7	0 19	6 8	77	1 8	0·89	16·4
Ground nut cake, decorticated, 6-7% oil	8 7*	1 9	6 18	73	1 11	1·03	41·3
Ground nut cake, imported decorticated, 6-7% oil	7 10	1 9	6 1	73	1 8	0·89	41·3
Palm-kernel cake 4½-5½% oil	7 10†	0 12	6 18	73	1 11	1·03	16·9
Palm-kernel cake meal, 5½% oil	7 12†	0 12	7 0	73	1 11	1·03	16·9
Palm-kernel meal, 1-2% oil	6 17	0 13	6 4	71	1 9	0·94	16·5
Feeding treacle ..	5 0	0 8	4 12	51	1 10	0·98	2·7
Brewers' grains, dried ale	6 2	0 11	5 11	48	2 4	1·25	12·5
Brewers' grains, dried porter	5 15	0 11	5 4	48	2 2	1·16	12·5
Dried sugar-beet pulp	From £5 10s. to £6 per ton, ex factory (according to factory)						

* At Bristol. § At Hull. † At Liverpool.

‡ In these instances manurial value, starch equivalent and protein equivalent are provisional.

NOTE : The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of December, 1938, and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative values of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, if linseed cake is offered locally at £11 per ton, then since its manurial value is £1 1s. per ton as shown above, the cost of food value per ton is £9 19s. Dividing this figure by 74, the starch equivalent of linseed cake as given in the table, the cost per unit of starch equivalent is 2s. 8d. Dividing this again by 22·4, the number of pounds of starch equivalent in one unit, the cost per lb. of starch equivalent is 1·43d. Similar calculations will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own markets. The figures given in the table under the heading "manurial value per ton" are calculated on the basis of the following unit prices:—N., 7s. 6d.; P_2O_5, 2s. 6d.; K_2O, 3s. 8d.

FARM VALUES OF FEEDING STUFFS

The prices in respect of the feeding stuffs used as bases of comparison for the purpose of this month's calculations are as follow :—

	Starch equivalent *Per cent.*	*Protein equivalent* *Per cent.*	*Per ton* £ s.
Barley (imported)	71	6·2	6 14
Maize	78	7·6	6 18
Decorticated ground-nut cake ..	73	41·3	7 18
,, cotton-seed cake ..	68	34·7	7 10

(Add 10*s*. per ton, in each instance, for carriage.)

The Table below is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values," which it is recommended should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows, are given in the December, 1938, issue of the Ministry's Journal, p. 965.)

FARM VALUES

Crop	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	7 3
Oats	60	7·6	5 19
Barley	71	6·2	6 19
Potatoes	18	0·8	1 14
Swedes	7	0·7	0 14
Mangolds	7	0·4	0 13
Beans	66	19·7	7 0
Good meadow hay	37	4·6	3 13
Good oat straw	20	0·9	1 18
Good clover hay	38	7·0	3 17
Vetch and oat silage ..	13	1·6	1 6
Barley straw	23	0·7	2 4
Wheat straw	13	0·1	1 5
Bean straw	23	1·7	2 5

RECENT OFFICIAL STATISTICS

Stocks of Grain, Potatoes, Hay and Straw remaining on Farms on January 1, 1939. The estimates furnished by the Ministry's Crop Reporters of stocks of grain, potatoes, hay and straw remaining on farms in England and Wales on January 1, 1939, indicate that, with the exception of hay, stocks are greater than those remaining at the commencement of 1938.

It is estimated that 772,000 tons of wheat, equivalent to 42 per cent. of the total crop, were still on farms on January 1; this quantity is 259,000 tons more than the quantity remaining on the corresponding date last year, and about 179,000 tons more than the average wheat stocks remaining on farms on January 1 in the five years 1934–1938. The stocks of barley on farms on January 1 are estimated at 294,000 tons, or 37 per cent. of the total crop, an increase of 155,000 tons compared with the stock which remained on hand at the same date last year, and 93,000 tons more than the average stocks for the five years 1934–1938. As regards oats, it is estimated that 563,000 tons, or 53 per cent. of the total crop, still remained on hand at the beginning of the year. This amount is 90,000 tons more than the stocks on hand on January 1, 1938, but is 16,000 tons less than the average of the previous five years.

Stocks of potatoes remaining on farms in England and Wales on January 1, 1939, were estimated to be 1,864,000 tons or 53 per cent. of the total production for the year 1938. This quantity is 354,000 tons more than the stocks remaining at the commencement of last year and is 327,000 tons more than the average stocks at the same date for the previous five years. This estimate relates to the total stocks of all potatoes remaining on farms and includes seed and chats, as well as the potatoes which may be withheld from the ware market under the regulations of the Potato Marketing Board. It also includes stocks remaining on the farms of producers who are not registered under the Potato Marketing Scheme.

The production of hay during 1938 was considerably less than in the previous year, and the stocks remaining were 1,903,000 tons less than at January 1, 1938, and 1,294,000 tons less than the average stocks for the five years 1934–1938. The stocks on hand at the beginning of this year were 2,897,000 tons, which represent 66 per cent. of the season's production. The quantity of straw on hand was estimated to be 2,455,000 tons, or 62 per cent. of the total crop, compared with an average of 2,326,000 tons over the period 1934–1938 and 2,024,000 tons at the beginning of 1938.

PROGRESS OF THE LAND FERTILITY SCHEME

The number of applications for contribution under the Land Fertility Scheme received from occupiers of agricultural land in the United Kingdom now exceeds 323,000. The quantities of lime and basic slag in respect of which these applications have been made are approximately 2,335,000 tons of lime and 630,000 tons of basic slag.

The Scheme came into operation on September 6, 1937. During the period September 6, 1937, to January 1, 1938, 52,000 applications for contribution were received in respect of 304,000 tons of lime and 154,000 tons of basic slag. In the corresponding period (September 4, 1938, to December 31, 1938) this season 71,000 applications have been received in respect of 634,000 tons of lime and 154,000 tons of basic slag.

WIRELESS TALKS, FEBRUARY, 1939

Station and Date	*Time : p.m.*	*Speaker*	*Subject*
National :			
Feb. 2	6.20	Mr Anthony Hurd	Farming To-day.
Midland :			
Feb. 7	8.0	—	For Midland Farmers.
,, 14	8.30	—	Midland Farmers' Club will discuss Sugar-beet.
,, 21	6.30	—	For Midland Farmers.
Welsh :			
Feb. 3	6 30	Messrs. R Alun Roberts and E. J. Roberts	Live Stock Problems in Wales : Principles and Problems of Grazing.
,, 10	7.30	Prof. R. G. White and Mr Moses Griffith	Live Stock Problems in Wales : Sheep-rearing.
North :			
Feb. 2	9.40	Mr. W. A. C. Carr	Making the Best of a Small-holding.
,, 16	8.0	A Conversation with a Farm Worker.	Labour.
West :			
Feb 2	6.40	Mr. A. W. Ling will introduce Messrs. S. G. Thompson and W. D. Hollis	Barley Growing and Selling.
,, 3	9 30	In the Chair : Mr. A. W. Ling. Speakers will include Messrs. A. Gregg, R. Roach and E. Harvey	A Visit to the Quarterly Meeting of the Federation of West Country Farmers. A Discussion on Bacon and Bacon Marketing.
,, 9	6.40	Mr. C. Hedderwick and a young farmer from Devon.	Poultry Farming.
,, 13	6.30	—	Agricultural Bee. Semi-Final, Cornwall *v.* Wiltshire.
,, 16	6.40	Mr. A. W. Ling and a Milk Distributor	A Discussion on Milk Distribution.
,, 23	6.40	Mr. Bennett of the Dorset N.F U. and a young farmer from Wiltshire.	A Discussion on Sheep Management.

FARM WORKERS' MINIMUM RATES OF WAGES

Agricultural Wages Board. At a meeting held on January 19, Orders were made continuing the minimum rates of wages unchanged in the following areas: Cheshire (35*s.*), Essex (34*s.* 6*d.*), Lincolnshire (Kesteven and Lindsey) (34*s.* 6*d.*), Worcestershire (33*s.*) and Denbigh and Flint (32*s.*). (The figures quoted are the minimum weekly wages for adult ordinary male workers). A further Order relating to Denbigh and Flint continued unchanged the minimum rates for forestry workers in that area (37*s.*). The Orders relating to three of the above areas made directions with regard to holidays with pay, the number of days to be allowed as holidays for whole-time workers in regular employment being, in Cheshire, 7 days for workers who normally work a 7-day week and 6 days for other workers; in Essex, 3 days with, in addition, one Sunday for workers normally required to work on Sundays; and in Worcestershire, 4 days. In all instances holiday remuneration is fixed at daily rates proportionate to the minimum rates. For full details of the minimum rates and holiday directions, and of the various provisions connected with them, reference should be made to the Orders, copies of which may be obtained free of charge from the Secretary, Ministry of Agriculture and Fisheries, Kings Buildings, Smith Square, London, S.W.1.

Enforcement of Minimum Rates of Wages. During the month ending January 10, 1939, legal proceedings were taken against 2 employers for failure to pay the minimum rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases follow:—

Committee Area	Court	Fines Imposed	Costs Allowed	Arrears of Wages Ordered	No. of Workers Involved
		£ s. d.	£ s. d.	£ s. d.	
Flint ..	Mold	2 0 0	1 17 6	29 0 0	1
Yorkshire .. (West Riding)	Huddersfield	4 0 0	0 6 0	15 10 0	1

RECENT OFFICIAL PUBLICATIONS

Fruit. A Summary of Figures of Production and Trade. In this now familiar annual summary, prepared by the Imperial Economic Committee, the estimates available for 1938 indicate that the world apple crops generally were smaller than in 1937 and below average. The United States crop is expected to be some 40 per cent. less than last season's large crop, but production in Canada is again heavy. The output of pears in the United States, the principal producing country, continues to expand steadily and the estimate for this season's crop indicates a new record.

The review shows that although the world trade in apples, pears, oranges, lemons and grapes in the three years 1935-37 was in most instances rather smaller than the averages for 1932-34, shipments of these fruits from Empire countries expanded appreciably, except for apples. In recent years, there has been an increase in the exports of bananas, grapefruit and canned fruit, particularly from Empire countries, and in 1937, the exports of each of these fruits and of oranges and grapes from Empire sources constituted new records.

Changes in the world output of the different kinds of fruit are difficult to measure accurately over short periods, but there is little doubt that since the War, the general tendency has been one of expansion. There was a big increase in the trade in apples after the War and in the years

1929-33 the average annual exports were more than double those of 1919-23, but in the past four years, exports of apples have been reduced.

The United Kingdom imports much more fresh and canned fruit than any other country in the world. Imports into Germany have declined in recent years; nevertheless, Germany is still the second most important market for most fruits except oranges and is the largest importer of grapes. A distinctive feature of the United Kingdon trade has been the marked growth of the imports from Empire countries, and in 1937 they accounted for over 61 per cent. of the total supplies. Price, 2*s.* 6*d.* (2*s.* 8*d.* post free).

Meat. A Summary of Figures of Production and Trade. The total amount of meat entering world trade showed a large increase last year, according to this report, just published by the Imperial Economic Committee. World exports of beef were considerably greater than in 1936 and there was an increase also in those of mutton, lamb and pig meat. Imports into the United Kingdom increased, the total costing nearly £85 millions as compared with £77 millions in 1936, while home production, after a period during which there was a steady upward movement, declined slightly.

World production and consumption of beef cannot yet be accurately determined for 1937 but probably exceeded even the high figures attained in the preceding year; the quantity entering international trade amounted to nearly 16 million cwt. and was greater than in any year since 1928. The United Kingdom's imports of beef again increased, with a larger proportion (29 per cent.) of the total coming from Empire sources, but the United Kingdom as a market for world exports declined in relative importance since larger quantities were taken also by most European importing countries. The production of beef and veal in Great Britain, which had increased by over 1½ million cwt. between 1930 and 1936, declined slightly in 1937 but accounted for nearly one-half of total supplies.

World exports of mutton and lamb, which for several years had been declining, recovered to some extent in 1937 when there was an appreciable increase in imports into the United Kingdom, almost the sole market for this class of meat. Over 80 per cent. of these imports were of Empire origin, as against 70 per cent. in 1931; lamb accounted for 78 per cent. of the total.

World pig meat production declined in 1937 owing mainly to a reduction in killings in the United States, but production in that country and in Europe should expand in 1938-39. Trade in pig meat is still dominated by the United Kingdom's imports of bacon and hams, which recovered slightly in 1937 after a heavy reduction in the four preceding years; the share of Empire countries in this trade has risen from 5 per cent. in 1932 to 29 per cent. in 1937, but Denmark still supplies nearly one-half of the total. On the other hand, about four-fifths of the United Kingdom's imports of pork last year were of Empire origin. Pig meat production in Great Britain in 1937 fell below the record figure attained in 1936 but was well above the average for other recent years.

In a survey of meat prices, the Report notes a marked increase in quotations for both home-produced and imported beef in 1937, when the latter averaged well above the corresponding figures for 1931. A somewhat similar though less marked movement occurred also in prices for mutton, lamb and pig meat. In all classes, however, the increase has not been maintained during 1938, quotations for home-produced mutton and lamb having been subjected to an especially sharp decline during the current year. Price 2*s.* 6*d.* (2*s.* 8*d.* post free).

NOTICES OF BOOKS

A Policy for British Agriculture. By Lord Addison. Pp. 304. (London : Victor Gollancz, Ltd. 1939. Price 7*s.* 6*d.*)

Those who desire to have more information about the Labour Party's agricultural programme than it is possible to obtain from the Party leaflets will welcome this book. In it Lord Addison gives a comprehensive exposition of his faith in the possibility of a complete restoration of British agriculture. He maintains that the agricultural land of this country has been allowed to fall into a deplorable state of under-cultivation, in consequence of which it is unable to provide either a proper standard of life for the producers of food who work on it, or a proper standard of nutrition for the consumers of food in this country. Lord Addison believes that with proper organization it could do both these things.

The present neglected condition of our agricultural land is attributed on the one hand to the inability of the private landlord at the present time to perform his proper function of supplying the necessary capital for the maintenance and development of the fixed capital equipment, and on the other hand to the lack of enterprise of the farmer, due to his uncertainty of the price that he will receive for his produce. Lord Addison proposes, therefore, in the first place, that the ownership of our agricultural land should be assumed by the State. This task would be entrusted to a National Agricultural Commission, which would be the supreme directing authority for the whole industry, subject to Ministerial control. The present owners would be compensated on the basis of an unstated number of years' purchase of the Schedule A value, with a right of appeal. Payment would be made in redeemable Land Bonds. It is considered that the transfer of ownership on this basis would provide the necessary funds for the redemption of the bonds and for a certain amount of development work without any charge on the Exchequer. The State would act as a good landlord. The National Commission would have the financial responsibility, not only for land purchase but for development and equipment and the provision of short-term credits for tenants. The actual duties of estate management, land and farming policy would be discharged by County Committees, which would consist of representatives of farmers and farm workers, as well as persons experienced in estate management and in the various technical sides of the industry, and other persons of special suitability. These Committees would be concerned with the provision and maintenance of a proper standard of equipment, advice upon the letting of farms, the consideration of proposals for farm amalgamation, for the establishment of demonstration farms, for the provision of better facilities for training and education, for making more freely available the benefits of improved knowledge and for the maintenance of a good standard of husbandry.

The wages of agricultural workers would be increased. There ought, in Lord Addison's view, to be a national minimum standard wage of £2 a week at the start, which would increase annually over a period of about ten years. This wage would be fixed by a National Wages Board reconstituted on similar lines and with similar powers to the Board that was in operation during and soon after the War.

The greatest bugbear of the farmer is said to be uncertainty of price ; therefore, it is not so much higher prices that need be aimed at as stability of price. Lord Addison is critical of the present "mixture of tariffs, quotas and quantitative regulation" which "is now being sought to be atoned for by a system of subsidies." He can see no reason why, if it is right to subsidize the payment for a joint of beef from the tax-payer, it is not equally right to help him to pay for his coals. He considers that the only self-respecting procedure and one that people will tolerate permanently,

is to have a price system under which the price paid by the consumer contains within itself an adequate remuneration for those who have provided the goods for him, and under which the consumer himself has an income that enables him to pay it. Applying this principle he sees no objection to the scheme of the Wheat Act, though he considers that the present standard price of 45*s*. per quarter is too high and that when his plan is in operation it could probably be reduced to about 37*s*. 6*d*.; at the same time he proposes that the acreage under wheat in Great Britain should be increased to over 4,000,000 acres producing 45 per cent. of our total wheat requirements. He considers that a workable scheme for the marketing of malting barley should not be difficult to establish, though lower grade barleys would have to be sold at competitive world prices subject, in any case, to well arranged marketing operations that would safeguard the producer from speculative price interference. For oats it does not appear to him that any artificial aid, apart from well-organized marketing operations, would be called for. Lord Addison is critical of the present Bacon Scheme; he doubts whether a subsidy for bacon production is necessary, but if it is he considers that a case can be made out for a levy subsidy for bacon and also for butter, operated in conjunction with an Import Board, in place of the existing Customs Duties. The prices of beef and mutton would be stabilized by the National Commission by the promotion of a proper abattoir system. The prices of other products would be stabilized by better marketing methods under the control of Producers' Boards; in some cases the details have yet to be worked out.

Imports would be controlled by special authorities on a commodity basis by means of a system of licences. These authorities would promote economies in insurance, transport, storage and marketing. The aim would be to ensure that the food supplies of the people were abundant and, at the same time, to give confidence to those who cultivated the land at home.

In addition to the general re-organization of marketing a very large increase in home production would be aimed at. Recent reports on nutrition are quoted to show what additional supplies of food would be required to ensure the adequate nutrition of the poorer section of our population. Lord Addison estimates that if these additional supplies were to be produced by British agriculture our home production of milk would be increased by 100 per cent., of eggs by 60 per cent., of fruit by 78 per cent., of vegetables by 60 per cent., and of meat by 25 per cent. He believes that this increased production is well within the capacity of a properly organized home agriculture. The key to this increased production is the plough, and the increased use of the plough would have to be centrally planned. In association with the County Committees the proportion that might be contributed by the different counties or regions would be assessed. Tenant farmers would be given special assistance for their cultural operations, in addition to the provision of the necessary buildings, drainage, roads, water supplies, fencing and the rest. Compulsion does not appear to be contemplated. It is considered that it would be possible to secure the execution of the plan with the goodwill and the co-operation of a large proportion of the existing farmers. In addition, large-scale farming operations would be carried out by a number of Farming Corporations, each in charge of their own large-scale farms. It is estimated that the existing arable area in Great Britain would be increased by 5,000,000 acres, the area under rotation grass by 7,500,000 acres and the area under fruit and vegetables by 400,000 acres, and that these additional acreages would increase the number of whole-time workers by over 200,000.

Very little is said about the cost of these huge operations, probably because it is assumed that they would be made to pay. The whole scheme is based on the principle that those who are doing useful work and helping to produce something that the people need are entitled, in return for their labour, to such payment as will enable them and their families to have a decent standard of existence. This standard is to be ensured by the payment of a just price. "If we have not income enough to pay a just price," says Lord Addison, "then it is our standard of income that is wrong; we ought to have money enough."

It will be realized that many aspects of this policy are acutely controversial. It would, therefore, be out of place to comment on the proposals here. It only remains to add that the book is written in an easy, almost conversational, style and that it is permeated by the genial good-nature and abounding faith that would be expected by those who have come into contact with Lord Addison.

Pig Breeding and Feeding. By C. Forman. Pp. 173. (London: Faber and Faber. 1937. Price 6*s*.)

This is a small book intended for the practical pig-keeper. The author has had many years of practical experience in keeping pigs and the chapter on "Instincts," with its close observation of pig nature, is a useful addition to the natural history of the animal. The book itself is rather a description of how the author runs his herd of about 60–70 sows than a reasoned description of the first principles which should be mastered by a beginner. A valuable aspect of the book is the importance placed on personal observation and attendance rather than reliance on gadgets. "The young litter should be against the sow's belly and not be cowering under a farrowing rail to save itself from annihilation" is a sentence that might well be written in letters of gold in many pig houses.

The book, however, falls badly between the two stools of practice and theory. Having stated that he has neither the time, inclination nor knowledge to theorize, the author proceeds to theorize in very unorthodox fashion on the possibility of applying the Mendelian theory to the production of a new breed by crossing the Wessex and Large White. Again, on the question of feeding the book is involved on the definitions of fibre, minerals and ash. A book of this nature would be much more valuable if these attempts at scientific explanation had been omitted and more space devoted to the author's obviously very wide experience of the practical problems of breeding and feeding.

Modern Flower Growing for Profit. By W. E. Shewell-Cooper. 2nd edition. Pp. 215. (London: Ernest Benn, Ltd. 1938. Price 5*s*.)

This book on "outdoor" flowers begins with a brief outline of the flower trade and contains chapters on mechanical cultivation, manuring, liming, etc. The numerous groups of flowers grown for market, pests and diseases, sprays and dusts, marketing problems, etc., are also dealt with, and methods of production of the more important flowers are described in detail.

A Survey of Egg Supplies and Consumption in a Midland Market Town. By J. B. Butler, B.Sc. Pp. 32. (Newport, Salop: The Harper Adams Agricultural College. Price 1*s*. 6*d*.)

This interesting and useful contribution to the knowledge of egg marketing is a close study of the flow of eggs from producers and the consumptive demand, in a country town of less than 10,000 inhabitants, for both home-produced and imported eggs.

The many and varied channels of disposal by producers which are

disclosed illustrate the need for organization to effect economy in distribution and to improve the quality of the home produce coming into consumption. Among the number of interesting points brought out on consumption are the sensitiveness of the market and the reaction of price fluctuations upon demand.

This intensive survey provides useful information to students of egg marketing problems which can be widely applied.

The Theory and Measurement of Demand. By Henry Schultz. Pp. xxxi + 817. (Chicago: The University of Chicago Press; London: The Cambridge University Press. Price 34*s*.)

This is a new work by an eminent authority on the statistical determination of the characteristics of demand curves—curves displaying the relations between, on the one hand, the quantities bought of various commodities, and on the other, their prices or other variable conditions of the market. Of these relations, the most interesting is generally the elasticity of demand.

Professor Schultz in this book undertakes both a complete theoretical discussion of the subject, and practical applications of theory to the demand curves for sugar, maize, cotton, hay, wheat, potatoes and other farm products in the United States. The theoretical discussion includes a thorough survey of the mathematical economic problems involved, a summary and critique of the methods of statistical determination which have been suggested by other writers, and arguments leading up to the various avenues of approach now favoured by Professor Schultz, which are new varieties of the general method of time series analysis in which he has been a pioneer.

For each of the commodities he obtains a quantitative description of the principal features of its demand curve according to several different formulæ. The elasticities of demand turn out to be distinctly below unity in every case (except some of the calculations for buckwheat). Wheat appears to display the lowest elasticity of any of the commodities. These results are, on the whole, what one would expect, but it is a great step forward to have obtained them in quantitative form, with a high degree of mutual corroboration among the different methods; and the value they should have in guiding policy under the A.A.A. and related aspects of the New Deal in agriculture is easily apparent.

Full appreciation of this very closely reasoned work may require in the reader considerable acquaintance with general mathematical method, mathematical economics, and statistical theory.

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NOTES FOR THE MONTH

Discussions on Agricultural Policy

Since the date of going to press of the previous issue of this JOURNAL, Colonel the Rt. Hon. Sir Reginald Dorman-Smith, M.P., has succeeded the Rt. Hon. W. S. Morrison, K.C., M.P., as Minister of Agriculture and Fisheries. Speaking in the House of Commons on February 1, the Minister recalled that in December last his predecessor had announced that the Government were undertaking a review of the agricultural situation and that it was intended to consult with the National Farmers' Unions of England and Wales and of Scotland in connexion with the considered views which had been advanced by those bodies. On February 7, the Minister and the Secretary of State for Scotland met representatives of the National Farmers' Unions of England and Wales, Scotland and N. Ireland for a discussion of the proposals put forward by the Unions. The discussions are being continued.

Assistance for Cereal Crops of 1938

In reply to a question in the House of Commons on February 23, the Minister said:—

> "The Government have given further consideration to the proposed additional subsidy to be paid to growers of barley of the 1938 crop which was announced on December 9 last. Since then, a general review of the agricultural situation has been undertaken and is now the subject of discussion with representatives of the farming industry. This general examination has included the review of the degree of assistance afforded to feeding barley and oats

under the Agriculture Act, 1937, mentioned in the concluding portion of the announcement of December 9.

"As a result of this review, the Government have reached the conclusion that it is necessary to give additional assistance to barley and oats and they propose that when the long-term policy has been finally settled it should be applied retrospectively, as far as is practicable, to both these cereals in respect of the 1938 crops. Although details of the policy are still under discussion, it is proposed in the forthcoming long-term legislation to remove the restriction contained in the Agriculture Act under which the receipt of deficiency payments for wheat renders growers ineligible for subsidy in respect of barley and oats, and to provide that assistance should, in principle, be available concurrently for all three cereal crops.

"No temporary legislation authorizing an increased rate of subsidy for the 1938 crop of barley will therefore be introduced, as was originally contemplated, and in the meantime growers of barley and oats whose applications have been accepted will, at the appropriate time, be paid the subsidy to which they are entitled under the provisions of the Agriculture Act, 1937. The sums so paid will be treated as advances of whatever revised subsidy payments are finally decided upon under the proposed retrospective provisions of the long-term legislation for these cereals."

PIG FEEDING STANDARDS

CHARLES CROWTHER,
Harper Adams Agricultural College

In view of the large part played by food costs in determining the cost of production of the fat pig, it is obviously desirable that the most complete and reliable information should be available as to the amount and kind of food-supply required at each stage of its life to cover its basic requirements and ensure such rate of progress as economic conditions may make desirable. From the large amount of information from experiments and practical experience that is available, tables of feeding " standards " have been crystallized from time to time. These tables, drawn up in different countries, show considerable divergences in detail, partly owing to the varying class of pig, and partly to differences in the systems of pig husbandry for which they were designed. In our own country the only " standards " based directly upon " home-grown " data are the Cambridge standards drawn up by the late Professor Wood, and the Harper Adams standards, both of which are based in the main upon data obtained with Large White pigs. Of the others, those probably most nearly applicable to our own conditions are the Scandinavian standards. In this article, therefore, I propose to review the present position with special reference to these three standards.

It is perhaps desirable to stress at the outset that the " standard " must not be interpreted as being an accurately determined and invariable figure, but rather as the best estimate we can form of the requirements of the average animal of good type, kept under good conditions, and well managed. It gives the stockman a guide as to what is probably desirable, but does not absolve him from the necessity of using his judgment as to whether with his pigs, and under his conditions, some adjustment up or down from the standard may be necessary.

Further, although the standards usually give data only for quantity of food and protein requirement, the other nutritive essentials, such as vitamin and mineral supplies, must not be overlooked, but must be considered separately.

In tables of feeding standards the weight of food is usually expressed in terms of "starch equivalent," but since the various meal mixtures used in pig-feeding do not vary much in starch equivalent value we shall not commit any serious error in assuming a starch equivalent of 65 per cent. for pig meals, and converting the starch equivalent data into weights of meal on that basis. Similarly, although the standard tables give protein requirements in terms of digestible protein, it is simpler in practice to assess the protein supplied by rations in terms of the " total protein " as given by analysis and quoted on the warranties supplied with feeding stuffs. I have, therefore, translated the digestible protein figures into the equivalents of total protein, on the assumption that in rations of mixed meals the total protein will be 75 per cent. digestible. Where a range of figures is given in the standards the average has been used.

The Empty Sow. Starting with the " empty " sow, one must discriminate between the young, still growing animal (gilt) and the full-grown sow, since the former, for obvious reasons, must be treated rather more liberally than the latter in proportion to its size to ensure that growth will be normally completed. Data based upon experiment are only scanty, but the Scandinavian standard seems to accord fairly well with English practical experience. According to this, a gilt that is being reared for breeding should, at about 260 lb. live weight, receive daily about 6½ lb. of meal containing ⅔ lb. of protein (or 10 per cent.). From this point onwards, as the rate of growth falls off, the food allowance can be reduced until at the fully adult stage no more than 1 lb. of meal daily per 100 lb. live weight need be allowed, with a total protein supply of about ⅓ lb. Throughout this period a feed of ground cereals, with or without a small proportion of weatings, will adequately cover the needs of the sow.

The In-pig Sow. When the sow becomes pregnant a little extra provision must be made for the developing embryos, and this will be primarily an increased requirement for protein. Experiments at Cambridge indicated that about 20 lb. of protein was stored up in the sow's body during the whole period of gestation, or an average of 0.17 lb. per day. To provide for this, the protein supply in the food must be raised by about double the amount, or, say, ⅓ lb. per day. The requirement

is not evenly spread over the whole period, however, but tends to increase as gestation progresses, especially in the latest stages, and it might be better, therefore, to give rather less than ⅓ lb. protein in the early stages, and more in the later stages of gestation; say for the first 5-6 weeks, 0.25 lb.; for the middle period, 0.3 lb.; and for the last third 0.4 lb. This might be given in the form of a mixture of 3 parts cereal meals with 1 part white-fish meal, allowing 1 lb. of the mixture in the first stage, 1¼ lb. in the second stage and 1¾-2 lb. in the final stage—these supplies being additional to the allowances for the empty sow given above.

Where, as is so widely the practice, the sow is run out on pasture, some part of the food requirements enunciated above will be obtained by grazing, the amount so taken varying greatly with individual sows and different pastures. Some sows on good pasture appear to need no supplementary meal food, although it is perhaps wise to give even them the small protein-rich allowance suggested as being required to cover the special needs of the growing embryos. For the average sow, however, a full day's grazing may be taken to represent 2-3 lb. of meal, and the standard meal allowance can be reduced by that amount.

A reminder may also be given here of the importance of ensuring a good supply of the essential minerals for the sow during the period of gestation, in order to ensure good reserves in the body for the subsequent lactation period.

The Suckling Sow. Our next stage is that of the farrowed sow suckling her litter, which for the first 3 or 4 weeks will subsist entirely on her milk. Whether the maintenance requirement of the sow is greater when she is in milk than when dry it is impossible to say, but it is certainly not less. As to the additional requirement to cover the production of milk, we can only form a rough estimate in view of the difficulty of ascertaining the actual milk yield of the sow. Such data as are available suggest that the milk flow is at its highest during the second to fourth weeks of suckling, and that the daily milk-yield of the average sow over this period is about 15 lb. Sow's milk is about one-third more concentrated than cow's milk and, assuming equal efficiency of conversion of food into milk in both animals, we should arrive at an estimate of about 4½-5 lb. starch equivalent (or 7-8 lb. meal) as being required to provide for the production of 15 lb. of sow's milk.

This, along with 4-6 lb. for maintenance (according to the size and bodily condition of the sow) gives us a total daily requirement of 11-14 lb. of mixed meals, which agrees exactly with the Scandinavian standard for a sow of 330 lb. live weight.

Similarly, with regard to the protein requirement, the 6.2 per cent. of protein present on the average in sow's milk means a secretion of 0.93 lb. protein in the daily output of 15 lb. milk. Assuming the same efficiency of conversion of food protein into milk protein as is implied in the commonly-used feeding standards for the dairy cow, we arrive at the figure of 1.5 lb. digestible protein (or 2.0 lb. total protein) as the sow's daily requirement of protein for her milk production, or about 2¼ lb. total protein for milk and maintenance combined. The Scandinavian standard prescribes an average of 0.5 lb. total protein per 100 lb. live weight and therefore agrees with my estimate at a live weight of 450 lb. The American standards of Morrison are rather lower at 1.6-1.7 lb. total protein for a nursing sow of this weight.

Reduced to simple practical terms, these estimates as to weight and protein content of food required lead to the conclusion that the sow of about 400 lb. live weight requires during the first half of the suckling period about 12-14 lb. per day of a meal mixture containing about 20 per cent. of protein. She will need rather less if out on grass.

A typical ration that would comply with this requirement would be a mixture of 40 parts weatings, 28 parts ground cereals, 10 parts linseed-cake meal and 12 parts white-fish meal. From the third week onwards, as the milk flow begins to decrease the quantity of feed and its concentration in protein-rich foods can be reduced, until, when near weaning, an allowance of about 8 lb. of food containing 17-18 per cent. protein will suffice, and we shall see presently that such a mixture also represents roughly what the newly-weaned pig requires.

Post-weaning Requirements. On the subject of the post-weaning requirements of the growing and fattening pig we have an abundance of data, and many standards have been formulated. These standards show considerable variations, both as to the quantity of food required at a given weight and the protein content. The data for weight of food are usually based, especially in the early growing stages, upon the amount of food that the average pig will take when fed to appetite

at two or three regular feeds daily. This is found to vary considerably with different lots of pigs, different rations, and different systems of management, which factors account mainly for the variations between the standards. Thus, the Scandinavian standards are based upon records of pigs fed mainly upon meals and separated milk, and therefore (including the meal equivalent of the milk) tend to be rather higher than the British standards based upon meal and water feeding. The Cambridge, Harper Adams, and Scandinavian standards for quantity of food, reduced to a common basis of live weights, are summarized below:—

Live Weight	Amount of Food Expressed as Weight of Meal Cambridge	Harper Adams	Scandinavian (Hansson)
lb.	lb.	lb.	lb.
30	1·6	1·5 (1·65)	1·9
40	2·1	1·75 (1·95)	2·5
60	3·0	2·5 (2·8)	3·45
80	4·0	3·3 (3·7)	4·15
100	4·6	3·9 (4·35)	5·0
120	5·3	4·45 (5·0)	5·8
140	5·9	5·0 (5·6)	6·3
160	6·45	5·6 (6·25)	6·7
180	6·7	6·05 (6·75)	7·1
200	7·0	6·6 (7·4)	7·55

It will be seen that there are considerable differences between the three scales at every stage, the Harper Adams scale being the lowest and the Scandinavian scale the highest, with the Cambridge scale just about the mean between the two. The data on which the Harper Adams averages are based include many groups of pigs that for various reasons ate badly, and when these are excluded the averages given in brackets are obtained, which differ but little from the Cambridge data. The latter may therefore be taken as representing with sufficient accuracy for our purpose the food consumption to be expected at the different live weights by healthy, thriving pigs.

The protein needs of the growing pig have formed the subject of many investigations, but rarely has the protein content of the ration been reduced to a point at which it was clearly inadequate, so that the evidence as to minimum requirements is hardly adequate to the importance of the subject. The general trend of recent work has been to suggest that the standards to which rations have hitherto been "balanced" are probably unduly rich in protein. This is strikingly

exemplified by the Cambridge experiments of Woodman and his colleagues reported in the current issue of the *Journal of Agricultural Science*. It has also been shown in the Harper Adams protein supply experiments. A careful survey of these and other experiments leads me to the opinion that, of the various standards proposed, the Scandinavian protein standards probably represent at present the nearest approximation to the quantities of protein that can be economically utilized under our conditions. In modified form (as explained above) these are set out below:—

Live Weight lb.	*Total Protein* lb.	*Live Weight* lb.	*Total Protein* lb.
30	0·320	120	0·660
40	0·375	140	0·690
60	0·460	160	0·720
80	0·545	180	0·740
100	0·615	200	0·750

Combining these standards with the Cambridge standards for weight of meal required, we arrive at the following data for the *percentage* of protein (total) that the ration should contain to comply with the standards:—

Live Weight lb.	*Protein Content of Food* %	*Live Weight* lb.	*Protein Content of Food* %
30	20·0	120	12·5
40	17·8	140	11·7
60	15·3	160	11·2
80	13·6	180	11·0
100	13·4	200	10·7

It only remains to indicate how these standards work out in terms of actual rations, which for mixtures of ground cereals, weatings, white-fish meal and extracted soya meal might be as set out below.

Live Weight	*Ground Cereals*	*Weatings*	*White-Fish Meal*	*Soya Meal*
lb.	%	%	%	%
30	33	50	12	5
40	44	43	8	5
60	60	31	4	5
80	65	30	2	3
100	66	30	2	2
120	72	25	1	2
140	75	24	0	1
160	79	21	0	0
180	82	18	0	0
200	88	12	0	0

The mixtures given are purely illustrative, and the proportions of individual foods may be varied considerably without disturbing the general protein balance. Thus, some feeders may prefer to include less weatings in the early stages, but they must then increase the proportion of protein concentrates. The ration for the 60 lb. pig might, for example, be 67 per cent. cereals, 23 per cent. weatings, 5 per cent. white-fish meal, and 5 per cent. soya meal. The amounts of protein prescribed are certainly ample for purposes of growth, and no evidence has yet been obtained that any further advantage, such as an increased amount of lean meat, can be obtained with a more liberal supply.

The warning must be repeated that vitamin supply and mineral supply need to be considered separately. With the rations given above it is doubtful if any addition of minerals is necessary, but about 1 per cent. of a 3 : 1 mixture of ground limestone and salt would be an adequate safeguard.

The last word as to what the rations shall be and how much shall be fed must be left to the stockman. He will ascertain by trial how the standard rations suit his pigs and the rate of progress secured. If this is not a good average rate he will not be justified in feeding up to the standards, especially in protein, but must adjust the supply to the rate of progress actually recorded.

TRENDS IN MODERN TRACTOR DESIGN

S. J. Wright,

Institute for Research in Agricultural Engineering, Oxford

Smaller Tractors. Among the most interesting of recent tractor developments is the introduction from America of a new range of small machines with a drawbar rating only about half that of the ordinary everyday tractor in what is commonly—but inaccurately—called the "10/20" class. Actually, the 10/20 class of tractor hardly exists nowadays, and most of the current machines so described have ratings of from 13 to 17 drawbar h.p. A typical tractor in the new range has a rating of 7 or 8 h.p.; weighs rather less than a ton in full working order; and is supplied, with pneumatic tyres as a standard fitting, at a cost of about £150. These new tractors obviously aim at eliminating horses from even smaller farms than are catered for by earlier models, and with this object in view can be supplied—in America at any rate—with a complete range of small-scale equipment. This includes directly-attached single-furrow ploughs, small cultivators and harrows, mowing attachments, and even a combine-harvester cutting a 3-ft. swath and capable of dealing with about 75 acres of grain crops in a normal season.

In the advertising matter relating to these machines it is claimed that they are "capable of tackling any job for which four good horses are required at present," and again that they represent "the ideal tractor for the 4-horse farm." Taken together, these two claims cannot be accepted as quite sound in relation to British conditions, for no *one* tractor, however versatile, can hope to replace *all* the horses on a typical 4-horse mixed farm. On the other hand, the first claim would appear to be sound enough by itself, for a properly-loaded tractor of 7 or 8 drawbar h.p. should do as much work as two pairs of horses in most jobs. For example, in everyday work the average "drawbar pull" of most horses does not exceed 250 lb., while one of these small tractors should be capable of a working pull equal to half its weight or, say, something over 1,000 lb. This pull would be sufficient for a two-furrow plough at 5 or 6 in. depth on medium land. Incidentally, these machines are called "one-plow" tractors by their

makers because they are thinking in terms of an American 16-in. wide furrow. One 4-horse job which one would not expect an 8-h.p. tractor to tackle at all comfortably is the single-furrow deep ploughing practised by some growers of potatoes and sugar-beet, because on this kind of work horses have very often to exert a good deal more than their normal pull of 250 lb. apiece.

So far as their external design is concerned these new tractors represent a compromise between earlier types. They are four-wheeled because all the defects of the tricycle type of tractor, and particularly those which arise when operating with an off-set ploughing load, become intensified when the scale of the tractor is reduced. On the other hand, they are not really four-wheeled row-crop tractors because, although their skeleton construction gives them a reasonably high clearance, and although their rear wheel track is adjustable to some extent, the track width of their front wheels is fixed. Provided a farmer is not too rigid in his ideas on row-widths, however, the new tractors should cover a very wide range of uses while involving the lowest possible first cost.

General Trend of Tractor Design. The second of the advertising claims mentioned above—that the new small tractors are particularly suitable for 4-horse farms—raises some interesting questions in connexion with which it is worth while to trace the general trend of development since the modern tractor became a practical proposition. As mentioned already, the once clearly-defined 10/20 class has become broken up into a variety of rather larger sizes; and much the same sort of thing has happened with what was formerly called the 15/30 class. In both, the immediate reason has been a sort of armament race—in which each maker in turn has tried to give his new model a little more power than his rivals' latest, without making any other very striking change in design. A parallel development started some 15 years ago with the introduction of the original three-wheeled " Farmall " tractor—the prototype of a whole series of 3- and 4-wheeled row-crop machines, all of which have since tended towards higher power to correspond with the ordinary agricultural models from which they were developed. Then, still more recently, came the first breakaway from the general trend in the shape of the " Baby Farmall," which, with the particular needs of row-crop cultivation in view, was deliberately made less powerful

than the smallest ordinary tractor then available. But the same tendency has operated—and even this special-purpose machine is now being superseded by a more powerful edition. Moreover, just the same sort of thing has happened with track-laying tractors—the so-called "tens" have gone out of existence, while all the "fifteens" have become "twenties and over"; although here there may be a special reason in the fact that the higher relative price of a tracklayer is less significant with a large machine than with a small one. Since this tendency towards higher power has operated with every class of tractor so far produced, it seems reasonable to anticipate that the same thing will eventually happen with the new smaller ones, because at every stage a manufacturer's programme is controlled by what the farmer wants. And, on the evidence available, it would appear that the average farmer sees no special virtue in smallness as such; and that although he may start with a low-powered machine because it involves the least possible expenditure, he is likely, when the time for replacement comes along, to be attracted by something bigger. Another factor contributing to the same result is, of course, the common practice of trading-in old machines in part payment for new ones because, in general, the more expensive the new machines the better the allowance on the old.

Before leaving this subject, however, it may be worth pointing out that although it may seem illogical to go to the trouble of making smaller models if they are destined eventually to develop into larger ones, the process is, nevertheless, good business for both manufacturer and farmer. For every new small low-priced tractor makes an appeal to a new market and lowers the scale of operations on which mechanized farming can be successfully demonstrated. Moreover, it is from the maker's subsequent efforts to achieve more power than his rival, without going to the expense of major alterations in design, that most of the very striking technical improvements of the last few years have arisen.

The Four-horse Farm. In attempting to recommend tractor equipment for this size of farm, one is faced with the difficulty that, in order to provide the necessary division of effort at busy seasons, it will nearly always be necessary to retain one or two horses whether, in theory, the power of the tractor alone is sufficient or not. It may, therefore, sound paradoxical to suggest that the smallest available tractor is not

necessarily the most suitable in the circumstances: yet this is the conclusion which the writer, at any rate, has reached. In the first place, unless he differs from the farmers who caused the developments outlined in the preceding paragraph, the man who buys the smallest available model to start with will almost certainly replace it sooner or later with a larger one. And this will mean either that he must replace a whole lot of still-serviceable implements at the same time or that he will work the new machine inefficiently because his implements are too small for it. But a still more important consideration is that if horses are available for the lighter work it becomes all the more desirable to increase the tractor-driver's output in the heavy operations—in which a larger machine can be fully loaded without difficulty and out of which most of the immediate financial benefits of mechanical power will arise. To be set against these points is the argument that the smaller tractor will mean less capital locked up in equipment—the more so because it can, if need be, work with horse implements with reasonable efficiency: but this is a better argument for having no tractor at all.

And, if we pursued the subject to its logical end, we should arrive at a second paradox: that the real place for the baby tractor is to be found on the large farm where there are no horses at all, and where the smallest tractor of the fleet is nearly always too big for its job.

THE SPACING OF SUGAR-BEET

F. H. GARNER AND H. G. SANDERS,
School of Agriculture, Cambridge

Despite the fact that sugar-beet has been an important crop in this country for the last fifteen years, and despite many experiments conducted on the subject, there is still considerable disagreement over the elementary question of the optimum spacing of beet. The best spacing is not, of course, merely that which will produce the greatest weight of sugar per acre. Within reasonable limits it may be true to say that the nearer the beet, and the more nearly the plants are left " on the square," the higher the yield; but close spacing means many small beet per acre and this involves very heavy labour, particularly in singling and lifting. Planting on the square must involve rows very close together, and this means more hand- and less horse-hoeing, particularly during the later stages. Experiments can only show how yield is affected by spacing and it must be left to the farmer to decide in his own circumstances how much yield he shall sacrifice in order to lessen labour.

When the crop was first introduced into this country, farmers decided that the close row distances common on the Continent would be uneconomic with high labour costs; the general practice was, and to a large extent still is, to try and compensate for wider rows by leaving the beet closer together within the row. Thus, it was hoped that little loss would be suffered in 24-in. rows if the plants were chopped out to only 6 in. apart in the row, as compared with a square spacing of 12 in.; both these spacings would give, with a perfect " plant," 43,560 beet per acre. The general conclusion, however, to be drawn from a multiplicity of experiments carried out in this country is that this hope is not fulfilled. Thus, in experiments conducted at Cambridge, with varying distances between the row, singling distances of 6, 9 and 12 in. showed no difference in yield of washed roots or yield of sugar. It is true that weight of tops was higher with the closer spacings in the row, but few farmers would be prepared to double the number of beet to be handled at lifting

for the sake of an extra half ton of tops per acre. It is probably perfectly safe to conclude that nothing is to be gained by spacing beet closer than 12 in. in the row, but it must be remembered that it is possible to take greater care over an experiment than over an ordinary field of beet, and better "plants" are obtained in the former; it is therefore probably wise to recommend farmers to aim for a spacing of 9 to 10 in. in the row, since when singling is done by piece work the natural tendency is to increase the distance somewhat beyond that prescribed.

As regards spacing between the rows, the farmer is limited by his drill; he can only vary the number of coulters included, so that with a 7 ft. 6 in. drill his possible spacings are 6 rows at 15 in., 5 rows at 18 in., or 4 rows at 22½ in. In the wetter districts of the country it is still common to grow beet on the ridge, it being held that early horse-hoeing is of paramount importance; furthermore, in wet weather it is a great advantage that tilth is not lost on the summits of the ridges, and also that ridges provide a bigger surface for evaporation. It is impossible in practice to make ridges closer than 24 in., and often they are 27-30 in. apart. The general result of experiments testing different row widths is that the narrower the rows the higher the yield, but the increase of yield obtained by putting the rows nearer together than 18 in. has often been slight; as row distances increase beyond 18 in. yield is apt to fall off rapidly. The following table gives the results obtained in four experiments on the Cambridge University Farm.

VALUE OF SUGAR PRODUCED PER ACRE, CALCULATED ON THE PRICES TO BE PAID IN 1939

Year	Distance Between Rows (in.)			Av. Yield Washed Roots (tons/acre)	Average Sugar (%)
	12	18	24		
1934	£37 10 9	£36 13 5	£34 16 5	13·5	18·03
1936	£47 13 1	£45 17 6	£44 18 0	17·3	17·87
	Distance Between Rows (in.)				
	14	17½	21		
1937	£36 15 6	£36 7 6	£33 17 11	15·1	15·77
1938	£31 19 9	£29 12 4	£27 4 10	12·6	15·76

The decrease in money value from the closest to the medium spacings averaged about 27*s.* per acre, whilst the decrease from the medium to the wide spacings averaged 38*s.* In view of the fact that there is difficulty in horse-hoeing rows closer than 18 in., farmers will probably be justified in concluding that the 27*s.* is not worth striving for, but that the 38*s.* is. The argument against rows closer than 18 in. is reinforced by the consideration that in practice many plants would be lost in closer work when horse-hoeing, so that for narrow rows the results would not be so favourable as in experiments, where due care to avoid this damage can be taken. It is claimed that good work can be done with row-crop tractors in rows as close as 14 in., but the vast majority of the beet grown in this country is still hoed by horses.

The first thought likely to occur to a farmer reading the above table would be that he would be well satisfied with any of the money returns shown, and it must be confessed that the four crops were well above the average of the country. This raises the question as to whether similar results would be obtained on crops conforming more to the average. It is, in fact, often argued that the optimum spacing of beet depends on the fertility of the land, the usual view being that good land requires fewer beet per acre than poor land, but experiments done on the widest variety of soils, from deep fens and silts to blowing sands, have all tended to show that a spacing of approximately 18 by 10 in. is the optimum. During the last two years this point has been attacked directly at Cambridge, where the attempt has been made to imitate good and poor land by high and low manuring. So far, no tittle of evidence has been obtained that optimum spacing is at all related to fertility of the soil.

Throughout the country considerable loss of yield is undoubtedly suffered because rows are put wider than 18 in.; but it is certain that even more loss is occasioned by the presence of gaps. In two experiments at Cambridge each plot was mapped, and each beet separately weighed with the object of determining the effect of gaps on yield. It was found that single gaps had relatively little influence on yield, since the surrounding beet compensated by their extra growth to the extent of 80 per cent. In a dry year the compensation approached 90 per cent., but in a wet year it was less complete. Yield then is not severely lowered by odd, missing beet, it is when several adjacent beet sites are vacant that loss of

yield is suffered, because then the surrounding roots cannot grow sufficiently larger to make up for the considerable bare space. Though odd, missing beet are of little importance, in a gappy field misses tend to occur in groups, with serious results; it is therefore sound practice to take every care to obtain a full " plant."

Summary. 1. There appears to be no point in singling beet to distances less than 9 or 10 in. in the row.

2. The optimum row distance, taking into account labour and convenience of working, is approximately 18 in.

3. The above two statements probably apply to practically all conditions in regard to fertility of the soil, and, as far as can be judged, in regard to season.

4. Whilst single gaps have little effect on yield, multiple gaps severely reduce it, and consequently it is worth while taking great care to obtain a full plant establishment.

MANURING FOR SUGAR-BEET

F. Hanley,
School of Agriculture, Cambridge

The disappointing results from last season's crop provide little encouragement to growers whose crops, despite liberal manuring, suffered a serious drop in yield by comparison with other seasons. But manuring is only one link in the chain of operations necessary to produce a good crop of sugar-beet, and it cannot overcome entirely the effects of unfavourable conditions such as the poor seedbeds, droughty periods and aphis attack so commonly experienced in 1938. Poor crops in one season are apt to influence the treatment of succeeding crops and often lead to a reduction in the manuring as a means of effecting a direct saving in expenditure. But the other costs incurred in the production of a sugar-beet crop remain very much the same whether manuring is light or heavy, and since both price and market are assured it seems false economy to cut down too drastically expenditure on a factor which, on the average of seasons, has been shown to play an important part in the production of good crops. Given favourable growing conditions, the sugar-beet crop will pay well for liberal manuring, provided other equally important factors, such as seed-bed, variety, time of sowing and early singling, receive proper attention.

For some years after the expansion in the sugar-beet acreage grown in this country, ideas as to the manurial requirements of the crop were based largely on Continental experience, all of which pointed to the need for liberal fertilizer treatment. But a considerable amount of experimental work on this subject has been done in this country during the last fifteen years and, during the last five seasons, in addition to local county trials, an extensive scheme of experiments has been carried out through the co-operation of the Rothamsted Research Station, the beet-sugar factories and now the Sugar Commission. The results obtained in these co-operative trials during the seasons 1933-37 are summarized in the Rothamsted Report for 1937. They endorse the views generally held as to the major requirements of the sugar-beet crop, but at the same time emphasize the variation in the response to fertilizers under different conditions and afford a useful insight into points of detail, such as the influence of the presence of one fertilizer on response to others and the response to the various fertilizers on different soil types.

One of the chief essentials in a sugar-beet crop is a full and uniform plant. To obtain this, good germination and strong vigorous growth in the early stages are necessary, hence the importance to the seedling of a good supply of readily available plant food. Phosphate in particular can have a very marked effect on the rate and vigour of growth of young seedlings and on soils that are low in phosphate the deficiency is likely to make itself felt most of all in these early stages.

In the first three years of the series of co-operative trials referred to above, applications of phosphatic fertilizer had little effect on yield of crop, a fact which, the report suggests, may be associated with the hot, dry summers of those years affording little opportunity for the phosphate to exert its full effect, for potash and nitrogen also had much less influence on crop yield in those seasons than in the succeeding two years. That phosphate is not a negligible factor, however, has been shown in several County trials, and its value in some circumstances was shown in the fourth and fifth years of the Rothamsted experiments (1936 and 1937). In those two years the response to phosphate varied considerably from centre to centre, but grouping the results according to soil type does not suggest that responses were confined to any particular type of soil, for coarse sands, light loams and clay loams each showed a profitable increase in yield from the use of a moderate dressing of phosphate. The variation in the response to phosphate at different centres, even on the same soil type, was shown by the 1936 results, for, on light loam soils, yield increases from 6 cwt. superphosphate varied from nothing up to 2½ tons of washed beet per acre, and similar variations were found on light sands and clay loams. Phosphate has practically no effect on sugar content, so that its value can usually be assessed by considering its effect on weight of beet per acre. How much phosphate can profitably be used for the sugar-beet crop must depend to some extent on the condition of the land and the general scheme of rotation manuring where such a scheme has been adopted.

It is suggested that the beneficial influence of phosphate on the growth of the young seedlings is in itself sufficient to warrant the inclusion of a moderate amount in all fertilizer mixtures for sugar-beet under ordinary circumstances. A comparison of the responses to 3 cwt. and 6 cwt. per acre of superphosphate in the above trials suggests that, though the heavier dressing was worth while in the season 1936, it is not

likely to be generally necessary in all seasons. On land in good heart about 3 cwt. per acre of superphosphate should be adequate, but on land in poor condition, especially where little or no phosphate has been applied in recent years, the quantity can be increased up to 5 or 6 cwt. per acre with the knowledge that, if the season is reasonably favourable, the extra expenditure will be justified. There is hardly sufficient evidence yet to judge the relative merits of different forms of phosphate. Experiments to compare basic slag and superphosphate have not given entirely consistent results. Prior to the introduction of the Land Fertility Scheme an increasing number of growers were trying basic slag as a source of phosphate on the grounds that it also helped to maintain the lime reserves of the soil. Although it sometimes achieved this dual function with reasonable success, the bulk of the experimental evidence suggests that it is no better than superphosphate even on acid soils and, in general, results tend to favour superphosphate as the source of phosphate, leaving the question of soil acidity to be dealt with by liming, especially with the financial assistance now available under the Land Fertility Scheme.

The pronounced effect of nitrogen on yield has been recognized almost universally for a long time, and this is borne out by the results of the 1933-37 Rothamsted trials. Although even 2 cwt. per acre of sulphate of ammonia failed to give a profitable response on the average of all centres in 1933, dressings up to 4 cwt. per acre proved profitable at most centres in each of the succeeding four seasons, the chief exceptions being those in very high condition, e.g., fen soils.

The wide response to nitrogen is shown by the fact that the largest responses were obtained on the lightest sands, whilst clay loams, at the other extreme, gave the second largest response. Sulphate of ammonia usually reduced the sugar content slightly, but the loss was more than compensated by increased weight of beet, a feature also observed in other trials.

INCREASE (+) OR DECREASE (−) FROM 4 CWT. PER ACRE SULPHATE OF AMMONIA

		Coarse Sands	*Light Loams*	*Heavy Soils*	*Fen Soils*
Washed Beet (tons per acre)	1936	+ 3·34	+ 1·58	+ 2·70	+ 0·63
	1937	+ 2·41	+ 1·66	+ 1·80	− 0·46
Sugar (per cent.)	1936	− 0·09	+ 0·03	− 0·33	− 0·66
	1937	− 0·47	− 0·17	− 0·15	− 0·56

A dressing of 2 cwt. per acre sulphate of ammonia reduced the sugar percentage by about 0.2 per cent., whilst 4 cwt. per acre gave an average reduction of nearly 0.4 per cent. The effect on weight of crop, however, was so marked that these two dressings of sulphate of ammonia actually increased the weight of sugar per acre by amounts worth considerably more than the cost of the fertilizer, and 3 to 4 cwt. per acre of nitrogenous fertilizer will usually prove profitable. To the grower who is interested in the tops as a stock food, it is worth noting that nitrogen increased the weight of tops—2 cwt. giving an increase of about 1½ tons per acre, and 4 cwt. about double that amount in the seasons 1934-37.

There is little new evidence as to the relative merits of different types of nitrogenous fertilizer, neither is there any reason to modify the statement made on previous occasions that there is usually no advantage to be gained from delaying the application of a part of the nitrogenous dressing for use as a top dressing.

Potash has been very widely advocated as an important ingredient in any sugar-beet fertilizer and, despite its known beneficial effects on other crops, it is probably used far more commonly in sugar-beet fertilizers than for other farm crops, except, possibly, potatoes. It has always been held to play an important part in the sugar content of the sugar-beet, besides influencing the effects of nitrogen on the plant. Experimental evidence on these points has, until recently, been rather indefinite so far as this country is concerned, and it was not easy to point to actual experimental results obtained in this country, to support these views. But the recent experiments do seem to provide definite evidence in support of the value of potash and its ability to influence both sugar content and response to nitrogen. In three of the five years of the Rothamsted Trials 1½ cwt. per acre of muriate of potash more than paid for itself, whilst 2½ cwt. per acre did so in two seasons. The effect of potash was particularly pronounced on light sands, light loams and fen soils, but was less certain on the heavier soils, as one might expect.

INCREASES (+) OR DECREASES (—) FROM 2½ CWT. PER ACRE OF MURIATE OF POTASH

		Coarse Sands	*Light Loams*	*Heavy Soils*	*Fen Soils*
Washed Beet (tons per acre)	1936	+ 0·84	+ 0·38	— 0·45	+ 1·00
	1937	+ 0·93	+ 0·60	+ 0·17	+ 0·96
Sugar (per cent.)	1936	+ 0·22	+ 0·14	+ 0·21	+ 0·26
	1937	+ 0·46	+ 0·13	+ 0·26	+ 0·10

The beneficial effect of potash is not due entirely to increase in weight, and that it frequently increases the sugar content slightly is shown by the results in the above table, based on data published in the Rothamsted Reports. In the five years 1933-37, muriate of potash at 1¼ cwt. per acre increased the sugar percentage by an average of 0.1 to 0.2 in each season, whilst a double dressing gave an average increase of 0.2 to 0.3 per cent. The close relation between potash and nitrogen was also brought out in these trials, for the effect of the two used together was greater than the sum of their separate effects.

EFFECT OF 2½ CWT. PER ACRE MURIATE OF POTASH ON RESPONSE TO SULPHATE OF AMMONIA

Increase in Yield of Sugar (cwts. per acre) due to 4 cwt. Sulphate of Ammonia

	1934	1935	1936	1937
With Potash	4·1	3·7	8·5	6·5
Without Potash	2·0	1·7	6·9	4·8

It seems important, therefore, to ensure that sufficient potash is present to enable the crop to make the best possible use of the nitrogen in the fertilizer mixture, and in general it seems as though 1½ to 2 cwt. per acre of muriate of potash or about 3 cwt. per acre of 30 per cent. potash salts should be given where dressings of 3-4 cwt. per acre of nitrogenous fertilizer are used on soils likely to need potash. On heavier soils, less in need of potash, about 1 cwt. per acre of muriate of potash is probably ample in most circumstances.

The foregoing suggestions in regard to applications of nitrogen, phosphate and potash assume that a moderate dressing of farmyard manure has already been applied where the crop is taken as part of the root shift. In the absence of dung the dressings of artificials should be increased slightly, especially the nitrogen and potassic fertilizers.

Two so-called " minor " elements of plant food that have given rise to deficiency troubles in a few districts recently are boron and manganese. Deficiency in boron is held to cause the condition known as Heart- or Crown-Rot of sugar-beet and mangolds, as well as certain troubles in other crops, e.g., " Raan " in turnips and swedes. In sugar-beet it is usually associated with very light sandy soils, often overlying gravelly or coarse sandy sub-soils, and liable to suffer from drought. It seems to be favoured by alkaline soil conditions and droughty summers. The effect on yield is usually only serious in a very dry summer, but the trouble can be easily

controlled at little cost by applications of borax to the seed-bed. Only very small quantities should be used, preferably 20-30 lb. per acre. Experiments in Norfolk, the results of which will be published shortly, show that even this small amount will last for at least 2 or 3 years. As regards manganese deficiency, this is associated with the condition known as "speckled yellows" in sugar-beet, as well as various troubles in other crops such as oats and potatoes. Here again the trouble seems to be confined to certain soil types, particularly light humus sands and certain types of fen soils, and is apparently favoured by alkaline conditions. The trouble can be controlled by applications of manganese in some form such as manganese sulphate, but the treatment is fairly costly and seems to remain effective only during the season in which it is applied. The best way to avoid these troubles is to seek advice from the County Agricultural Organizer wherever their presence is suspected or anticipated and also before applying heavy dressings of lime on these special types of soil. It is waste of time trying to grow sugar-beet without liming on these or any other soils, if they are seriously in need of lime; it is simply a question of applying the right amount of lime.

MODERNIZING AND MECHANIZING OLD FARMING PRINCIPLES AND METHODS ON THE WILTSHIRE HILLS*

T. K. JEANS,

Broadchalke, Salisbury

I have been farming from one thousand three hundred to two thousand acres in Wiltshire since 1918 and the changes and chances with which farmers have had to contend during this period have been perplexing and, at times, extremely depressing. They certainly are at present.

In 1918 I took over about one thousand three hundred acres of very hilly land near Salisbury. The greater part is very poor land on the chalk hills. It had been farmed well for many years in the old-fashioned way. A flock of 600 breeding Hampshire ewes and 200 tegs were kept. They received practically no concentrates and consumed nearly all the hay that was produced on the farm. No hay was sold off the farm. A very strict rotation of cropping was maintained, being from two- to six-field courses. The short course was followed on the good ground near the water meadows, and the long course (wheat once in five or six years) on the poor land on the hills. The sets of fields were carefully arranged to provide a continuous supply of field food for the sheep throughout the year in such a way that the ewes could get out for grazing on the downs and lie back on the arable land at night. Twenty-five to thirty carthorses were in work. There was no dairy. A few dry cattle to eat the surplus oat and barley straw were kept in the hill yards during the winter months. All water for stock had to be hauled from the river except for dew ponds which were often dry in the summer. The lambs were always given river or spring water. It was found that they did not do well on stagnant water. The fall in the prices of sheep and grain after the War, together with the high price of labour, made it quite evident that changes had to be made without delay. Either labour had to be reduced or output per man had to be increased proportionately. The latter policy was adopted.

* This article is substantially a Paper read at the 1939 Oxford Farming Conference, and is reproduced by the kind permission of the Conference Organizers.

A water supply was laid on, and the downs and pennings fenced. The number of Hampshire ewes was reduced to 400, and a grass flock of three hundred Cheviots was bought to run the fenced downs and pennings. This flock now consists of third and fourth cross Hampshire ewes which have retained the roving habit of grass sheep. One set of arable fields was laid down to permanent pasture to maintain a 50-cow dairy. This change increased the number of mouths to feed and reduced the number of acres to till. The hay not required by the grass sheep was given to the cows. The downs and pennings had to be improved to keep the grass sheep, and more sheep food had to be grown on the arable land to keep the arable sheep. A few roots and kale in mid-winter were found to be a great help and stand-by for the grass sheep. The rotation of cropping was not changed, but better sheep-keep crops were grown with the help of more artificial fertilizers on swedes, kale, rape and turnips. More hay and better aftermaths on the temporary grass leys were procured with nitrogenous manure applied in the early spring. The Hampshire lambs were marketed earlier in the year by forcing them with concentrates, with the exception of the best ram lambs which were kept for breeding. The grass lambs proved very successful. They thrived well, and, without being given concentrates, were sold fat off the newly-fenced downs and pennings which some of the older farmers had thought to be of no grazing value. This seemed very easy money and I was sorely tempted to sell my Hampshire flock, lay most of the arable down to grass and run one thousand grass ewes. But it had taken many years of careful breeding and attention to establish the Hampshires, and it was decided that they must stay at least until the grass flock had proved its worth. I was nervous of departing from the rotation of cropping which had always produced continuous food for sheep and which had not only kept them healthy and thriving, but also maintained the land in a clean and fertile condition.

The grass flock did not do quite so well during the second year. They had pulled out hard the old downs and pennings, and the grass did not come on until late in the summer. There appeared to be no clover whatever on this ground when they were fenced. I tried some experimental plots with basic slag in January and February on those parts of the downs which had been pulled out very bare. This experiment proved very successful. A mass of wild white and red clover appeared in the

early spring and we again had a good year with the grass sheep. It is essential that basic slag should be broadcast *on the ground* and not on grass. The best results were obtained on the areas of old down and pennings which had been pulled out very bare by stock, and then well dragged with a pitch-pole before broadcasting slag. Some of these plots are still clearly visible after ten years.

Plenty of roots were grown on the arable land. Those adjoining the downs were folded by the grass sheep running in and out by day and lying back in the pennings at night. This reversed the old order of robbing the downs for the benefit of arable land.

The improvement of the grazing and stock-carrying capacity of the land which had been slagged (8 cwt. per acre) was certainly two to three hundred per cent. The grass sheep were increased to keep pace with it. The result, however, was disappointing, for the lambs did not do so well and the larger quantity made a less money total. The following year we gave them concentrates. They responded very slowly and the result was not a complete success. The ground was sheep sick, as known to the older generation of farmers and now known to be infected with intestinal sheep worms. Either a rest from sheep, or the plough was essential.

At this time (1929) I bought an adjoining arable farm of about six hundred acres and, owing to the general farming conditions then existing, hastily laid most of it down to grass. My grass flock was sent there, and the downs and pennings grazed with cattle which did well. The grass flock did well for a couple of years, but again the sheep sickness appeared on this farm, and new pastures were essential. These pastures have now all been ploughed and cropped successfully under a system of alternate husbandry and occasional fallowing. This land is too low and too heavy a clay for arable sheep, but the grass sheep do well on the temporary leys. By careful management of grass sheep on pastures, together with mixed stocking, it is possible to prevent pastures becoming infested with intestinal worms and other troubles, but my opinion from experience is that this is far more difficult and dangerous than the management of an arable flock. On most of my land, I now favour the plough and cashing the fertility of the pastures in grain and hay, and keeping them healthy for all classes of stock, including milking cows. My impression is that young cattle do not contract husk in new pastures,

and cows undoubtedly milk far better on them. My experience of trying to renovate old weedy pastures has proved a waste of time and valuable fertility.

During the period I have covered (1918-29) the arable land was reduced, but the rotation of cropping was never changed on the hill farm. I had great difficulty in getting the cultivations done *when they should have been done.* Instead, they were done when we had time. The land was in good heart and the rotation could not be easily improved. The younger men, however, did not like working with the horses, and I had many crop failures as a consequence of the delay in sowing, haymaking and harvesting. Overtime was expensive, and, in any case, it was not an economic proposition to work tired horses during the evenings.

My experience of the tractor up to 1929 was far from encouraging. It was frequently out of order and hindering the horses. I engaged a first-class mechanic, hoping that he would keep it in order, but he much preferred dismantling the tractor to working with it. It now seemed obvious that the only course was to mechanize with modern machinery. I found the young farm hands were interested. Each man took a pride in the tractor which was allotted to him and for which he was made responsible. He preferred working on the land to dismantling the tractor. At first I had two wheel tractors, but on the hilly ground there were many jobs they could not do owing to wheel spin, and it became obvious that a track-laying tractor was essential. It is a great advantage to have a tractor that does not dig itself in easily, and which will plough a hilly field the way it should be ploughed, even if it is up-hill. On level farms I do not think that track-laying tractors are necessary. There is certainly less capital outlay and less depreciation on a wheel tractor.

I tried tractors for hay sweeps, but soon discarded them in favour of old motor cars with light sweeps. This, in my opinion, is one of the greatest advances we have made. Haymaking is quickly over in good weather and there is much other important work on a mixed farm that can can be done with great advantage at this time of the year, e.g., cleaning fallow ground from roots, hoeing roots, etc. I am still of the opinion that singling roots by hand (certainly sugar-beet and mangolds and usually swedes, early rape and kale) pays well if you have the labour at the right time. I have many times noticed that corn is better after roots that have been

singled by hand. With regard to labour I endeavour to balance the work at all times of the year. Casual labour is difficult to obtain when required. Profitable work for a permanent staff throughout the year should be our objective. Farmers should, I suggest, mechanize with this object in view. It is, of course, difficult, and we are obliged to lose sight of profitable work at some seasons of the year.

A small combine harvester, power driven from the tractor, is a very useful implement. We harvest about one-third of our corn in this way. I have not invested in a drier. The harvester is used only when the grain is dry enough to store. Grain soon dries when standing. The machine I have is certainly very efficient, with a maximum capacity of about 130 sacks of wheat per long day. It is very economical in labour, requiring a tractor driver and one man taking off the sacks. It relieves us of the necessity of threshing directly after harvest at a time when there is so much else to be done, such as cleaning ground and preparing for wheat sowing. The combine is particularly useful for barley. It cuts as low as a binder and makes a good sample. Barley can take a lot of rain when standing and often improves, but if it gets wet in stook it is usually spoilt. We sweep up the straw behind the combine with motor sweeps and bale it with an automatic, string, straw baler. My combine does not work well on hilly ground, and the more level fields have to be selected for it. There are large combines built for adjustment on hilly ground, but those I have seen are far too heavy and cumbersome in transport for my farms. I am hoping to see this improvement in the smaller combines. My combine threshes clover seed very well, either from the rick or standing. To thresh standing clover it must usually be a first cut and be very dry. I am doubtful if aftermath clover seed would ever be sufficiently dry to thresh standing in late September or October. I rick aftermath clover seed and thresh it with the combine from the rick in the spring. I should not care to combine all my corn for several reasons.

(1) Too great a rush of work at harvest, which would result in delay.

(2) Corn is fit to cut with a binder a week or ten days before it is fit to combine.

(3) A large grain store would be necessary or one's corn would be forced on the market.

(4) It would be difficult to deal with all the straw before it was spoilt.

(5) The wheat straw is not suitable for thatch.

A tractor power binder is, in my opinion, the quickest way of cutting corn. If it is possible to make the ricks with an elevator in the field in which the corn stands it is a great advantage. Three horses in three light farm wagons, preferably with pneumatic tyres, will keep two good pitchers working. This is, in my opinion, one of the quickest and most economical methods of harvesting corn. When not combining barley we carry it in this way, directly behind a power binder. I hope never to stook barley again. Two or three horses are kept on each farm and there is usually work that can be done by them far more cheaply than with tractors. We have several old lorries costing about £12 each. They are very useful. The light ones are very suitable for hay sweeps, standing up to the work better than cars, and also for hauling hurdles and water, and for general farm haulage in dry weather. In wet weather in winter the horses do most of the haulage. Pneumatic tyres on carts, wagons and water-carts are a great help and seem to be a profitable investment. Pneumatic tyres for wheel tractors are not very popular with us. They are always removed soon after harvest. We use them for the power mower, binder and combine. If they have a heavy pull or if the ground is hilly, it appears that they do more damage in rolling spring corn than iron wheels with cleats. The crawler is preferred for this work.

For threshing we have a light American automatic-feed thresher which can be taken anywhere on the farms. We removed the straw blower from this thresher and fitted the automatic straw baler in its place. It has a chaff-blower with pipes to carry the chaff some distance on either side of the thresher, thus eliminating the unpleasant job of moving the dust and chaff as is necessary with English threshers.

Five men only are required to work this set: two on the corn rick, two taking off sacks and attending to machinery and one stacking bales. It is quite impossible to haul our heavy English thresher (which is still used when straw is required for thatching) to many of the fields in winter. Before we had the American thresher, the corn had to be hauled to rick yards, often a very slow and expensive task. The American thresher is very convenient for threshing from the field and has a larger output than the English machine. As it has a peg drum

the straw is not suitable for thatch, but is better for litter, and, as manure, it is more easily spread in the fields.

It has always been difficult to keep thatch on the ricks in this hilly country and extra long spars were always used, often with poor results. For the last two years we have used a new thatching needle. It was awkward to use at first, but this year it has been used with great success. After the severe gales we have had since harvest, the only thatch which did not require attention was where the needle had been used.

An Australian combine drill used for drilling grain and fertilizers together, with cultivator tines, has been very successful. It has greatly increased the corn yields. The machine is only twelve feet wide. Very wide machinery is not convenient on this farm. Twenty to twenty-five acres a day can be drilled comfortably. It is absolutely essential that these combine fertilizer drills should be completely dismantled and thoroughly washed and repainted with a non-corrosive paint after spring and autumn use. Otherwise an expensive and necessary implement is soon rendered useless and sowing will be delayed. Concentrated fertilizers have given the best results with this drill. A proportion of the wheat ground is, however, ploughed and pressed, and the seed broadcast. Later, wheat, after sheep, is ploughed in and if artificials are used for this they are mixed on the farm. Evenness of distribution is not so difficult as with more concentrated manure.

Sugar-beet can, I think, be introduced into the rotation of cropping by displacing a proportion of the folding crop before wheat. The large amount of labour required for hoeing and lifting has been a great difficulty and hinders other important work unless good casual labour can be obtained. I am hoping new machinery may remove the lifting problem shortly.

The cutting out of the root and forage crops and relying on alternate husbandry, grass and corn is a suggestion to be considered, but a large capital expenditure on fencing and watering has to be met, and the problem and expense of keeping the ground clean is not avoided, fallowing being essential. On suitable land a milking bail would undoubtedly maintain fertility. Here again, I should favour the plough and cashing the fertility.

It is my belief that animal manure is essential to maintain most ground in profitable fertility.

The old and proved courses of cropping (generally known as the four course) combined with alternate husbandry (grass

and corn) are the most practicable means of maintaining a large head of healthy stock on the type of land I am farming. Careful mechanization to suit individual farms, together with the careful use of artificial fertilizers and food concentrates, has made and, I trust, will continue to make the farming of this land a profitable and healthy occupation. This system should support the maximum number of contented workmen, both agricultural and industrial. Without the assistance of the wheat quota, however, I should have been forced to have reduced my labour bill by two-thirds of its present amount, and also my contribution to the production of real wealth in the form of such necessities of life as meat, milk, bread and wool would have been reduced proportionately. These considerations are important in this thickly populated and island country.

I suggest as a farmer that the wheat quota has enabled us to farm our land. I strongly deprecate the farming of the wheat quota, which seems to be the general idea of many people I have heard speak of mechanized farming. I fear this will eventually bring its own retribution to those who practise it.

TWO-FIELD COURSE near Water Meadows

1938. {Wheat.
Ploughed and sown to rye or winter barley in September.

1939. Folded by sheep, ewes and lambs, night fold, and folding water meadows by day in May. Ploughed and drilled to rape and turnips about middle of June.
Folded in September and ploughed and pressed and sown to wheat.

This short course maintained this land in good fertility for many years. It is doubtful if this would be possible without the folding back from the water meadows. It usually gives extremely good sheep keep at a time when it is often difficult to obtain and the sheep do not damage the water meadows as cows do.

The water meadows have now been reserved for the dairy, and as a substitute for the sheep, Wibberly rape kale, winter barley and hop (trefoil) and Italian (catch crop) is grown on the hills in the longer Course sets of fields, and these fields divided into a Four-Course Rotation to supply mangolds, marrow stem kale and hay for the dairy.

FOUR-COURSE rotation for providing dairy with mangolds, kale and hay

1938. Wheat.
1939. Half mangolds, half marrow stem kale.
1940. Barley over-sown to clover.
1941. Clover hay.

A heavy dressing of farmyard manure is given in the winter before mangolds and kale.

FIVE-FIELD COURSE (without yard manure) good barley land as second crop after sheep

1938. Wheat. Plough early in autumn for spring barley.
1939. Drill barley with concentrated fertilizer, over-sow with clover and rye grass.
1940. Hay. Aftermath part folded part seeded clover ploughed and pressed in September and sown winter vetches.
1941. Vetches folded in June. Cleaned and sown in three parts—kale—Wibberley rape kale—rye and/or winter barley.
1942. Folded in succession, kale, rape kale, rye, winter barley, in March-April. Ploughed in May and drilled to rape and turnips to be folded before wheat.

Wibberley rape kale has been sown with great success for sheep feed for about ten years. It comes into flower from a fortnight to three weeks later than ordinary rape or kale, and gives good sheep feed at a difficult time of the year. Some years it is a valuable crop for human consumption before folding by sheep.

SIX-FIELD COURSE on light land (hilly) which will grow good barley as second corn crop after wheat

1938. Wheat—Should be ploughed in early autumn for spring barley.
1939. Drilled to barley and sown to clover and rye grass.
1940. { Hay. Aftermath folded or seeded clover. Ploughed and pressed and sown to wheat with artificial.
1941. { Over sown to hop (trefoil) and rye grass in April. Wheat.
1942. Hop and rye folded ploughed and pressed, dressed down and sown to swedes and kale.
1943. Swedes and kale folded, from lambing pen made in field and manure heaped on site of pen.

Ploughed in March and sown to spring vetches which are folded in July. Lambing pen manure hauled out and ploughed and pressed for wheat.

During the last six years wheat has been substituted for spring oats after hay, which necessitates ploughing and pressing in October-November instead of January.

SIX-FIELD COURSE on high and poor land not good barley ground

1938. Wheat. Ploughed early after harvest and drilled to wheat again with complete artificial manure.
1939. Wheat over-sown to grass.
1940. Hay. Aftermath fed by grass sheep.
1941. Old field folded in spring, ploughed December.
1942. Sown either { Swedes and kale or / Oats and over-sown to trefoil and Italian Ryegrass. }
1943. Either { Swedes and kale folded and sown spring vetches. / Trefoil and Italian folded and sown to rape and turnips. } Folded and sown to wheat.

POTATO SILAGE

STEPHEN WILLIAMS
Midland Agricultural College

Potatoes can be stored for feeding purposes by three methods: clamping, drying and converting into silage. The process of clamping is too well known to need description, and the drying process is essentially a factory one. Potato ensilage, however, is a new, simple and practical method of preserving potatoes for stock-feeding.*

The method used at the Midland Agricultural College is as follows:—

The potatoes are washed thoroughly with water and steamed (for about 45 minutes) until they are well cooked, at a cost of about 3*s.* 7*d.* per ton of raw potatoes.† During the steaming process the potatoes lose about 10 per cent. of their weight, and during the subsequent cooling period they lose a further 5.5 per cent. Immediately after the potatoes are taken from the steamer they are mashed and packed tightly together while still hot and air is completely exuded from the mass. The silage is then covered with wet sacks and these in turn with a heavy layer of clay well rammed down. The cost of cooking and ensiling amounted to 8*s.* 0*d.* per ton, a figure which could be much reduced if the work were done on a commercial scale.

A new type of silo is now being tested for this purpose. It consists of two parallel oblique walls, 4 ft. high, 4 ft. apart at the base and 5 ft. apart at the top, forming a trench in which steamed potatoes are placed, well compacted and finally covered over with bags and soil. Each side wall is made up of several cheap, flat, iron sheets (20 gauge) surrounded by straw and supported by 4 in. × 3 in. posts, approximately 6 ft. long, sunk obliquely in the ground.

A period of 2 to 4 weeks should elapse before the material is fed. During this period, as reported by Thompson in the *Kirton Agricultural Journal* (April, 1938), the weight of silage decreases because there is a further loss of water. The dry

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* Wallace and Thompson have described three methods of ensiling potatoes in a previous issue of this JOURNAL (Dec. 1931), and a fourth method has been described by the Bacon Development Board in their booklet, *Substitutes for Cereals in Pig Keeping* (1937).

† No charge for depreciation of plant.

matter content of the silage increased finally to 31.2 per cent. It has been shown in Germany that, even after many years, storage losses in nutritive value are very small indeed and in our experience practically all the material taken out of the silo is consumed by pigs.

Feeding Trials. Since in a national emergency our cereals would be required for human consumption, it was thought desirable to find how far a home-grown bulky crop, potatoes, could be fed in place of cereals in pig rations. The method of feeding the potato silage was similar to that recommended in Germany by Lehmann and found to be satisfactory, using steamed potatoes, at the East of Scotland College of Agriculture.

According to the Lehmann system, a pig receives 2.2 lb. daily of a ration composed of 70 per cent. cereals and 30 per cent. protein-rich foods and a supplementary ration of potatoes (or other starchy foods) fed according to appetite. As the pig grows its appetite increases, and consequently it consumes more potatoes, thus widening the protein to carbohydrate ratio of its whole ration.

Eight pairs of pigs were selected on the basis of age, weight (about 60 lb.), breeding and sex, and one of each pair was allocated to each of Pens 1 and 2. The pigs were slaughtered as soon as convenient after they reached 195 lb. live weight. The supply of potato silage was exhausted shortly before all the pigs reached the required 195 lb. weight, and the experiment was then concluded. Pigs in Pen 1 were fed throughout with 2 lb. per head daily of the following protein-rich ration:—

Weatings	3 cwt.	Fish Meal	1½ cwt.
Flaked Maize ..	1 ,,	Meat and Bone Meal (60% albs.) ..	1½ ,,
Maize Meal	1 ,,	Cod-liver Oil ..	1 gal.
Barley Meal ..	2 ,,		

In addition, they received for a period of five weeks (Period I) a cereal supplement (2 parts barley meal and 1 part flaked maize) fed to appetite.

Then potato silage was offered to this group, and since they did not appear to relish it, eating at first only ¾ lb. each daily, flaked maize at the rate of 1 lb. per head daily was fed mixed with the silage. At the end of another 5 weeks (Period II) the pigs were eating 3½ lb. potato silage, and the provision of flaked maize was no longer necessary. During the remainder of the experiment (Period III) this group received only potato silage fed to appetite as a supplement to the 2 lb.

per head daily of concentrates. The rate of consumption of silage increased from 6.8 lb. to 15.0 lb. per head daily during this third experimental period.

The progress made by these pigs was compared with that of their counterparts (Pen 2) which received the following rations fed initially at the rate of 2¾ lb. meal per head daily and increasing by ¼ lb. per week until 7 lb. meal per head was reached.

	Early Stage	Final Fattening Stage
Weatings	4 cwt.	3½ cwt.
Flaked Maize	2 ,,	2 ,,
Maize Meal	1 ,,	1 ,,
Barley Meal	2 ,,	3 ,,
Fish Meal	1 ,,	½ ,,
Minerals (2 pts. limestone, 1 pt. dairy salt)	10 lb.	10 lb.
Cod-liver Oil	1 gal.	1 gal.

The results of this first experiment are summarized in Table I.

TABLE I

Treatment	PEN No 1 (Modified Lehmann System)			PEN No. 2 (Standard Practice)		
Period	I	II	III	I	II	III
Rate of Feeding :—						
Balanced meal (lb. p. day)	—	—	-	2¾ to 3½	3½ to 5	5 to 7
Protein-rich ration (lb. per day)	2	2	2	- -	—	—
Cereal supplement (lb. per day)	1 to 1½	1	—	—	—	—
Potato silage (lb. per day)	—	¾ to 3½	6·8 to 15·0	-	—	—
Date of commencement of periods	4/5/38	8/6/38	13/7/38	4/5/38	8/6/38	13/7/38
Average initial live weight (lb.)	63 2	90·0	124·6	61·5	94·1	132·0
Average final live weight (lb.)	90·0	124·6	181·6	94·1	132·0	191·5
Average live weight gain (lb.)	26·8	34·6	57·0	32·6	37·9	59·5
Average live weight gain per week (lb.)	5·36	6·92	8·79	6·52	7·58	10·62
No. of pig-days in each period	280	280	303	280	280	313
Total amount of meal consumed (lb)	809	836	717	896	1138	1942
Total amount of potato silage consumed (lb.)	—	676	3682	—	- -	—
Total meal equivalent consumed (lb.) equating 3½ lb. silage to 1 lb. cereal meal	809	1044	1850	896	1138	1942
Meal equivalent per lb. live weight increase	3·78	3·77	4·07	3·43	3·73	4·08

It is shown in the above Table that in period I, Pen 1 (modified Lehmann System) did not progress as well as Pen 2—they gained at the rate of 5.36 lb. per week and consumed 3.78 lb. meal per lb. live weight gain as compared with 6.52 lb. per week and 3.43 lb. meal per lb. gain, corresponding figures for Pen 2. It is clear that throughout the three periods the pigs receiving potato silage grew more slowly than the others. Either the bulkiness of the silage set limits to the calorie-intake and thus retarded growth, or the constitution of the pigs had been adversely affected by the excessive amounts of protein fed in the early stages. The latter view is supported by two facts: firstly, the pigs during Period I had dirty, greasy skins, and, secondly, later trials show that the level of protein supply throughout was excessively high and could with advantage to the health of the pigs be considerably reduced.

It was found from a simple mathematical treatment of the results of this experiment that 3¼ lb. potato silage are equivalent to 1 lb. cereal meal in nutritive value.

TABLE II

Group	No. of Pigs in Group	Average Initial Live weight (lb.)	Average Final Live weight (lb.)	Duration of Feeding Period (days)	Average Live weight Increase per week (lb.)	Rate of Feeding		Food Economy (lb. meal equivalent per lb. live weight increase)
						Meal (lb. per day)	Potato Silage (lb per day)	
Groups receiving fattening Ration only.	7	112·0	162·0	35	10·0	5 to 6¼	—	4·0
	9 decreasing to 8	140·4	192·3	35*	11·1	6 to 6¾	—	4·0
	8	160·6	190·3	24	8·7	5 to 6¼	—	4·8
	8	171·4	205·7	24	10·0	6 to 6¾	—	4·6
Groups receiving 3 lb. Weaner ration per pig and potato silage fed to appetite.	8 decreasing to 7	115·6	148·1	24*	10·4	3·0	7·2	3·7
	6	140·0	198·8	35	11·8	3·0	12·6	4·1
	8	152·2	184·5	24	9·4	3·0	8·6	4·2
	7 decreasing to 5	154·6	203·7	35*	11·9	3·0	11·0	3·8

* Pigs were removed for sale during the period of experiment from groups thus marked.

The results of a further series of Trials are set out in Table II. In these trials four groups were fed on a cheap standard fattening ration composed of:—

Weatings	2 cwt.	Tapioca Flour	2 cwt.
Bran	½ ,,	Meat and Bone Meal (4% oil)	½ ,,
Flaked Maize ..	1 ,,	Minerals	20 lb.
Maize Meal ..	2 ,,	Cod-liver Oil	1 gal.
Barley Meal ..	2 ,,		

and four corresponding groups were provided with 3 lb. per head daily of the ration usually fed to newly-weaned pigs from 8 to 14 weeks old and with potato silage according to appetite. The weaner ration was composed of:—

Weatings	5 cwt.	Barley Meal	1 cwt.
Flaked Maize ..	2 ,,	Fish Meal	1 ,,
Maize Meal ..	1 ,,	Minerals	20 lb.
Cod-liver Oil	1 gal.		

Table II provides information regarding number of pigs in groups, duration of feeding period, rate of feeding, rate of live weight gain, food economy, etc. The conversion factor 3½ lb. potato silage equivalent to 1 cereal meal has again been used in arriving at the food economy figure.

From the above table it appears that, in effect, 3½ lb. potato silage are at least equivalent in nutritive value to 1 lb. cereal meal and that in this series of experiments the pigs receiving potato silage made slightly better progress in live weight increase than those receiving an all-meal ration. This result is contrary to the findings of the previous trial and is explained by the fact that protein-intake was at a more satisfactory level in these latter experiments. The live weight gains of, and the economy of food conversion by, the silage pigs are regarded as highly satisfactory, and the adoption of this method of feeding ensiled potatoes is recommended for pigs of the weights indicated in the Table. Briefly, feed 3 lb. weaner ration containing only 10 per cent fish meal, or its equivalent, with unlimited supplies of potato silage.

Representative pigs were sent to Messrs. Marsh and Baxter's Bacon Factory at Brierley Hill. The grading of all pigs was very satisfactory, the majority in every pen being Grade A, though the quality of the hams in all carcasses after a period of two months storage was inferior, presumably on account of the feeding of rations too rich in oil right through to the final stage. The fat was described by the Factory Chemist as soft, oily, yellow and rank. There is, however, no evidence to show that potato silage has any ill effect on carcass quality.

Summary and Conclusions. (1) Potato ensilage is a successful and economical method of conserving potatoes for

feeding to pigs. Very little or no nutritive value is lost in storage. The cost of manufacture on a small scale amounted to 8*s*. 0*d*. per ton of raw potatoes, which include the cost of steaming. This figure could be considerably reduced under normal working conditions.

(2) The silage may be fed to pigs weighing from 115 to 200 lb. at the rate of 7-15 lb. per head daily with 2 lb. meal mixture (containing 0.6 lb. protein-rich foods), or up to 12½ lb. daily fed with 3 lb. meal mixture (containing 0.3 lb. protein-rich food).

(3) Very satisfactory results were obtained by giving pigs of 115,200 lb. live weight unlimited amounts of potato silage with 3 lb. of a simple weaner ration containing 50 per cent. weatings, 40 per cent. cereals and 10 per cent. fish meal.

(4) Three and a quarter pounds of silage were equivalent in food value to one pound of cereal meal mixture.

PLOUGHING UP AND RE-SEEDING POOR GRASSLAND

H. I. Moore,
Department of Agriculture, The University, Leeds

Introduction. A survey of Yorkshire has shown that, in common with other counties, there is a large acreage of poor worn-out grass land in serious need of improvement. Nowhere is the need greater than in the industrial parts of the West Riding, where the combination of a smoke-laden atmosphere and soils inherently very deficient in lime has resulted in such deterioration of the pastures that only from the most drastic treatment can any substantial improvement be expected.

The common method of improvement adopted in the past with land of this type has been to harrow drastically and to follow with applications of lime and other fertilizers. Occasionally a simple seeds mixture would be sown. Whilst such treatment undoubtedly brings about a marked improvement in the herbage, it has the disadvantage of being a slow method. In most instances two or three years have to elapse before the improvement is appreciable, and even then a tremendous amount of the original inferior herbage usually persists, and this always tends again to become dominant. Success or failure of this " renovation " largely depends upon the efficiency of the harrowing, which must be sufficiently drastic to tear up the matted turf and expose the soil. Such work involves a great deal of labour, particularly in the removal of the dead vegetation which is torn out.

From time to time various improvements in the method of " renovation " have been suggested, but the method which now seems to offer the greatest prospect of success is that of ploughing up the old turf and sowing down again immediately. Such a method has certain quite obvious advantages over the " renovation " method. Firstly, a clean seedbed is provided for the sown grasses and clovers so that they have a better chance of competing successfully with indigenous weeds.

Secondly, by this method lime and slag can be incorporated in the soil to best advantage. Thirdly, and perhaps most important of all, the benefits are obtained rapidly.

Object of the Experiments. The information available on the question of ploughing up and re-seeding is very limited. That it can be done successfully has been demonstrated at several centres in the country, but there is a great deal still to learn as to the methods which should be adopted to ensure success under the widely varying soil and climatic conditions. In a national emergency great reliance would have to be placed on our grass land for maintaining the supply of essential human foods such as milk, and every effort should therefore be made to bring our poor pastures into good order as speedily as possible. On a large scale much of the work would probably have to be done by contracting firms employing suitable teams and implements, and it is therefore vitally important that one should be in a position to indicate to such firms as well as to farmers how the work can best be carried out.

It was for these reasons that a series of trials in ploughing up and re-seeding was started in Yorkshire early in 1938. Already a considerable amount of information has been obtained from these experiments, and as the conditions in Yorkshire are representative of those in many other parts of the country, it was thought to be desirable to place this information at the disposal of farmers and others without delay.

Plan of the Experiments. Nine centres were chosen as being typical of large areas in the county where much of the grass land was in urgent need of improvement.

In the first season the following points were under investigation:—

1. The relative merits of ploughing up and re-seeding as compared with the renovation of the existing turf by harrowing, manuring and re-seeding.
2. A comparison of spring seeding with summer seeding.
3. The use of a nurse crop as against no nurse crop.
4. The influence of fertilizers on the resulting sward.
5. The value of indigenous strains of grasses as compared with the cheaper commercial strains.

Two and a half acres of land were treated at each centre

and the layout of the plots was as indicated in the plan below:—

Ploughed in Winter. Sown Down in Spring. Nurse Crop of Oats			Ploughed in Winter. Sown Down in Spring. Nurse Crop of Italian Ryegrass			Ploughed in Winter. Sown Down in Spring. No Nurse Crop			Ploughed in Winter. Sown Down in Summer. No Nurse Crop			Renovation Plot. Harrowed in Winter. Seeds Sown in Spring		
COMPLETE MANURE (Lime, Slag, Potash and Nitrochalk)														
NO MANURE														
SLAG ALONE														
LIME AND SLAG														
LIME ALONE														
A	B	C	A	B	C	A	B	C	A	B	C	A	B	C

A = Indigenous strains of grasses. B = Commercial strains of grasses
C = Half indigenous strains of grasses. Half commercial strains of grasses

LIME was applied at all centres according to the lime requirement. At two centres, hydrate of lime was used, at one centre burnt lump lime and, at the remaining centres, ground burnt lime.

BASIC SLAG, 10 cwt. per acre high grade (15-16 per cent. p.a.) high soluble were applied at all centres.

POTASH, 2 cwt. 30 per cent. potash salts per acre were included in the complete manuring at all centres.

NITROGEN, 2 cwt. nitrochalk per acre were included in the complete manuring at all centres.

The fertilizers were applied on an average one month before sowing the seeds, except for the summer-seeded plot. To this the nitrochalk was applied in July, prior to seeding.

FIG. 1. *Left*: Ploughed and re-sown 1938. *Right*: Renovated 1938. Note the coarse herbage on renovated portion. Stock refused to graze this part of the field.

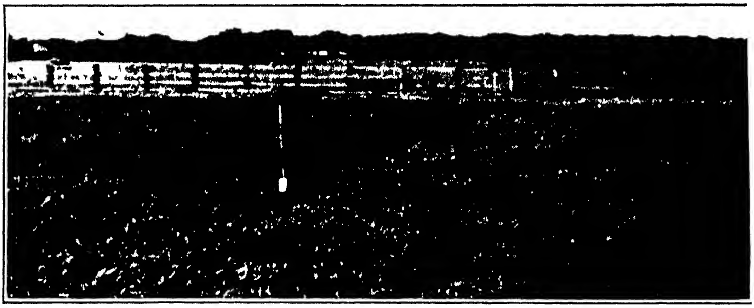

FIG. 2.—Ploughed and re-sown 1938. *Left*: Basic slag 10 cwt. p.a. *Right*: No manure. The dark colour is due to presence of clover.

FIG. 3. Centre strip ploughed and re-sown 1938. Remainder of field untreated. Stock refused untreated strips.

(Photographs Copyright H. I. Moore.)

The same seeds mixture was used at each centre, viz:-

Perennial Ryegrass	16 lb. per acre	37 lb. per acre.
Cocksfoot	10	
Timothy	4	
Rough Stalked Meadow Grass	1½	
Late Flowering Red Clover ..	4	
Wild White Clover	1½ ,, ,,	

One-third of each plot (A on plan) was sown with the above mixture containing indigenous strains of ryegrass, cocksfoot and timothy; one-third (B on plan) was sown with the commercial strains of these grasses, and the remaining third (C on plan) was sown with a mixture containing half indigenous and half commercial strains of the grasses mentioned.

The type of soil and the predominating species in the original herbage of the plots is indicated in the table below:—

TABLE I.—SOIL TYPE AND ORIGINAL HERBAGE AT VARIOUS CENTRES

Description of Centre	Lime Requirement	Fine Leaved Fescues	Bent	Yorkshire Fog	Other Species Mainly Weeds and Other Weed Grasses
	cwt /CaO	%	%	%	%
Coal Measures Sandstone .. Mining district. Stock-carrying capacity negligible.	42		9	87	4
Coal Measures Sandstone .. Industrial area. Stock-carrying capacity negligible.	35	8	10	77	5
Coal Measures Sandstone .. Mining district. Stock-carrying capacity poor.	40	85	7	—	8
Millstone Grit .. .. Moorland district. Stock-carrying capacity very poor.	38	42	43	5	10
Millstone Grit .. .. Moorland district. Derelict grass.	45	90	—	5	5
Millstone Grit .. .. Dales district. Stock-carrying capacity very poor.	35	56	15	—	29 including 15% decumbent heath grass)
Boulder Clay .. .. Grassland area. Stock-carrying capacity very poor.	30	—	85	4	11
Glacial Sand .. .. Mixed farming district. Stock-carrying capacity poor.	25	35	26	26	13
Bunter Sandstone .. .. Arable district. Stock-carrying capacity poor.	25	—	80	10	10

Botanical analyses have been made of the herbage since re-seeding in order to compare the different methods of seeding down and also the effect of manurial treatment.* The first series of readings was taken when the plots were showing signs of good growth (in most instances about mid-July) and the last set of readings at the end of the grazing season in October.

TABLE II.—BOTANICAL ANALYSIS OF RE-SEEDED PLOTS
(Averages for Eight Centres†)

Manuring	Complete Manuring		Lime and Slag		Slag		Lime		No Manures	
Month when Analysis Made	July	Oct.	July	Oct.	July	Oct.	July	Oct.	July	Oct.
	%	%	%	%	%	%	%	%	%	%
1. SPRING SEEDING — NO NURSE CROP:										
Grasses	72	80	66	78	58	67	36	60	23	35
Clovers	26	20	17	19	30	32	11	10	12	11
Weeds§	—	—	5	3	3	1	13	15	15	34
Bare Ground	2	—	12	—	9	—	40	15	50	20
2. SPRING SEEDING—NURSE CROP, ITALIAN RYEGRASS:										
Grasses	71	83	70	80	58	70	45	60	46	54
Clovers	28	17	18	20	32	23	13	14	12	16
Weeds§	—	—	2	—	3	7	10	20	14	21
Bare Ground	1	—	10	—	7	—	32	6	28	9
3. SUMMER SEEDING — NO NURSE CROP:										
Grasses	—	67	—	69	—	65	—	71	—	57
Clovers	—	22	—	21	—	24	—	10	—	10
Weeds§	—	9	—	8	—	8	—	10	—	13
Bare Ground	—	2	—	2	—	3	—	9	—	20

† At one centre, owing to poor consolidation of the furrows and the unfavourable weather in the early part of the season, Yorkshire Fog growing through the furrow seams became completely dominant and hence the results from this centre have been omitted from the table.

§ Weed grasses are included.

In the renovated plots over 95 per cent. of the original herbage persisted, whilst for the spring seeding under a nurse crop of oats the percentage of bare ground in October was over 30 per cent., and weeds and weed grasses accounted for a further 20 per cent.

At all centres germination was very much retarded by the protracted drought of spring and early summer, but the

* For this purpose the POINT QUADRAT method of analysis has been used. Ten readings were taken from each 1/10th acre plot, the readings being taken along the diagonal of the plot.

broken weather that followed greatly favoured the establishment of the sward, which, by the autumn, was excellent at most centres.

At four centres where rotational grazing was practised it was found possible to get some measure of the productivity of the different plots by weighing the grass from sample foot squares immediately before grazing began. Ten such squares were cut from each plot and were weighed green on the spot. Care was taken to sample when the grass was dry. The results from the various centres were remarkably uniform, but it is not desirable to lay too much emphasis on the results obtained in the first year. The average results for the four centres are shown in Table III.

TABLE III.—WEIGHT (TONS PER ACRE) GRASS PRODUCED DURING SEASON 1938
(Average Figures for Four Centres)

Manuring	Complete Manuring	Lime and Slag	Slag	Lime	No Manures
SPRING SEEDING:					
Nurse Crop Italian Ryegrass	13·07	10·86	10·56	8·77	6·00
No Nurse Crop	11·78	9·99	10·81	7·04	4·22
Nurse Crop Oats		Light grazing after harvest			
Renovation	6·02	3·56	3·63	3·50	3·59
SUMMER SEEDING:					
No Nurse Crop	4·56	2·77	2·69	1·98	0·84
CONTROL (Original Sward) ..	—	—	—	—	3·97

Discussion of Results. One of the first observations is that ploughing must be well done. A flat furrow should be turned, the old turf completely buried, and the furrows well packed. There is no doubt that a furrow press is extremely useful for this work, but where this is not available other means can be adopted to get the same effect. For instance, one farmer made a press out of an old wagon, whilst another adapted a tractor and a two-furrow plough to take one furrow and so allow the tractor wheels to run on the top of the previous furrow and pack it down firmly. Early ploughing is desirable in order to allow plenty of time for natural consolidation to take place. Following ploughing, disc harrows are useful for working down the furrows without bringing the old turf to the surface. Prior to sowing the seeds the land should be rolled, preferably with the Cambridge roller. This leaves the soil in small furrows, into which the seeds will drop. They

can then be harrowed in with a set of light harrows and finally rolled with the flat roller.

At only four centres was a good crop of oats obtained. Birds accounted for three of the failures and wireworm damage for the other two. It is obvious that in a purely grassland area it is not wise to sow oats or any other cereal as a nurse crop. In other districts it is a debatable point as to whether a nurse crop is desirable. Where the oats succeeded the seeds mixture is now looking quite well, but in each instance a high percentage of weeds and weed grasses have become established, and there is a decided danger that they will become the dominant species as time goes on. On the other hand, the plots sown without a nurse crop of corn are almost weed free, the sward is filling up, and much valuable grazing has been obtained already. During the coming season it is hoped to obtain additional evidence on this point.

Earlier grazing and more bulk was obtained by the inclusion of Italian ryegrass as the nurse crop. The presence of this grass did not appear to have affected adversely the clovers (see Table II).

In the plots sown down in summer, great difficulty was experienced in keeping the land clean between ploughing and seeding, and our experience indicates that, where summer seeding is contemplated, ploughing should take place immediately prior to sowing. In a normal season the seeds will then have sufficient moisture for germination and with rapid establishment will smother the weeds.

In spite of early setbacks due to the very dry weather in spring, good results were obtained by sowing without a nurse crop at all.

Regarding renovation, at two centres fairly good results were obtained following very drastic harrowing with a pitch-pole harrow. At the other centres the original species dominated the sown species to such an extent that the latter were almost completely ousted. Even where good results were obtained, the renovated plots did not compare with the adjacent ploughed and re-sown area. On these latter plots, over twice the bulk of herbage was obtained, and this herbage consisted of good grasses and clovers in contrast to the coarse, poor-quality grasses of the renovated plot. In only two instances would stock graze the renovated grass land. In all the others they refused to graze these plots and remained the whole time on

the re-sown plots. The result was that the renovated plots became very coarse, as indicated in Fig. 1. It is very evident that the measure of success to be obtained by this method depends largely upon the efficiency of the preliminary harrowing, which must be really drastic in order to be effective.

At each centre the plots receiving a complete manuring (i.e., lime, slag, potash and nitrochalk) were very good and the figures in Table II show how these plots filled up and were weed free. At several centres they were strikingly good. But at the same time remarkable results were obtained from the use of slag alone (see Fig. 2), and it would appear that in the establishment of new pasture phosphates in some form are essential. Lime applied according to the lime requirement of the soil in all instances had an appreciable improvement over control. This, however, was by no means so marked as that from slag, nor was the plot receiving lime and slag any better than that getting slag alone. It is probable, however, that the lime and slag plots will show to advantage in subsequent years. The folly of seeding down without fertilizers was strikingly demonstrated, and the figures for botanical analysis and yield of grass confirm this.

It is as yet too early to draw conclusions regarding the value of the indigenous strains of the grasses used in the seeds mixture. So far no visible differences have been noted.

At most centres the young pasture was grazed by cows and young stock and the sward did not appear to suffer from this treatment in any way. Certainly, at those centres where hay was taken, the sward is now much more open in the bottom, is coarser, and Yorkshire Fog is present to some extent.

The following pointers which have been obtained from these experiments are worthy of emphasis:—

(1) Good ploughing is essential. The old turf must be completely buried and the furrow made solid. If summer seeding is contemplated, ploughing should be deferred until the summer.

(2) Nitrogen aids the rapid establishment of the sward and so keeps weeds in check.

(3) Phosphates are essential—in these trials, high grade, high-soluble basic slag at the rate of 10 cwt. per acre gave excellent results.

(4) A cereal nurse crop is not essential and the indications are that it is undesirable. Oats are risky in a grassland district. The inclusion of Italian rye grass gives earlier grazing.

"BROWN HEART" OF SWEDES

F. T. BENNETT,
Advisory Mycologist, King's College, University of Durham
AND
L. E. EDNEY,
Vice-Principal, Cumberland and Westmorland Farm School, Penrith

Brown Heart disease of swedes was first noticed in the British Isles by Pethybridge in Ireland about 1913. The first record of its occurrence in England was apparently from Cumberland[1*] in 1932, in which area it is probably more prevalent than elsewhere in this country. The disease occurs to considerable extent also in north and mid-Wales, and to less extent in Devon and Cornwall. It has been recorded also from the east Midlands, East Anglia, Berkshire and Hampshire. In Scotland, where it is called "raan," it is prevalent in the south-western area. The trouble occurs in various parts of Europe, America and New Zealand, the discovery of successful treatment being made in Canada.

Brown Heart is not a trouble that has arisen recently—it has been known under the name of " star rot " in Cumberland for more than twenty years—but all farmers with experience of it are agreed that it has become worse during the past ten years and continues to get worse each year. Now that the cause of the trouble is known, and because it is linked up to some extent with the use of lime, and, probably, basic slag (see p. 1234), it is advisable to bring this matter to the notice of farmers in view of the increased use of these materials under the Land Fertility Scheme.

Features of Brown Heart. Swedes are affected most frequently and severely, yellow- and white-fleshed hybrids to lesser extent, and common white turnips rarely. Affected swedes show no sign of the trouble externally; the roots must be cut through the middle to show the defective part. It has been found on several farms where it was unknown to the farmer because he had never cut the roots in this way. The middle part of the root is brown in colour, or ranging from greyish to nearly black, with mottled effect arising from the concentric or scattered arrangement of the discoloured parts.

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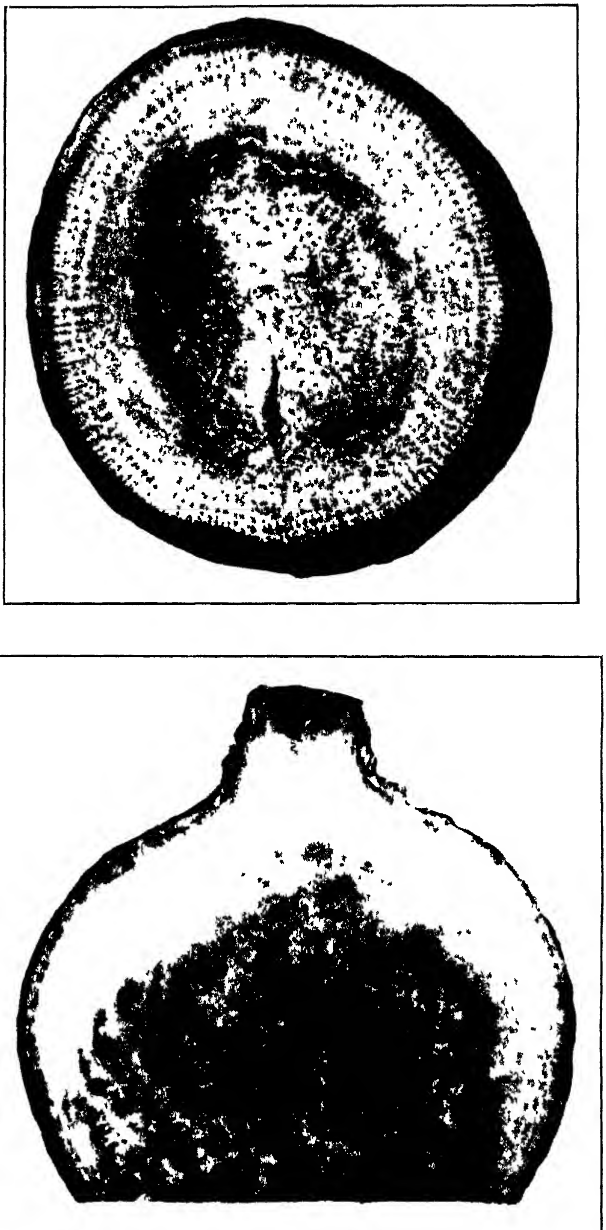
* For references see p. 1239.



Brown Heart in Swedes
Above Cross section *Below* Vertical section

To face p. 1232

This discoloured area never reaches as far as the skin, nor does it extend into the root proper or into the crown. The symptoms can be seen from an early stage of bulbing, but become more clear as the roots grow and ripen; in badly-affected mature roots there may be small cracks in the discoloured part (Fig. 1).

Effect on Roots. When Brown Heart is the sole trouble, affected roots are not smaller in size, nor do they rot. The brown parts are tough and slightly bitter, and these features are merely accentuated during storage. Such roots are useless for household purposes, being stringy and tasteless when boiled. Sheep evidently find them less palatable, as they frequently leave the brown parts untouched in the field, or nose out of the troughs the brown parts of cut roots. Further, they are of lower feeding value owing to increase of fibre and decrease of nutrient substances as shown by the following analysis[2]:—increase of fibre, 2 per cent., approximately; decrease in soluble carbohydrates from 3 to 4 per cent.; reduction of sugar, as much as 12 per cent. Thus, although Brown Heart does not reduce the crop as regards yield (unless in exceptional circumstances), it causes loss in a way the farmer would not notice; this loss is serious when from 50 to 90 per cent. of the roots are affected. On some fields in Cumberland it has been impossible in recent years to grow a useful crop of swedes, and common turnips have been largely substituted with serious economic interference in the buying, feeding and selling of sheep.

Cause. Not until 1934 was it discovered that Brown Heart was due to a lack of available boron in the soil, and that it could be prevented by application of some boron compound, of which borax was the most useful form. Boron is not required by plants as a food, like nitrogen, phosphate and potash, but in minute quantities only to serve in the physiological processes of growth. After this discovery it was necessary to ascertain for each locality what amount of borax was needed and how this could best be applied. All investigators have emphasized that to apply more borax than the soil needs would endanger not only the root crop but probably succeeding crops also. Hence the need for the field trials in Cumberland and Westmorland, which are summarized below; alongside borax a typical proprietary article was used because farmers sometimes prefer something ready to apply, even though more expensive, if efficient.

Field Experiments in Cumberland in 1938. Eleven trials were laid down, two of them proving abortive for a reason mentioned later. Each trial occupied six 1/5th acre plots; all were dunged according to custom; four plots received turnip fertilizer, the other two having sulphate of ammonia, basic slag and potash salts, so that all plots received N, P_2O_5, and K_2O in equal amount. The slags and special dressings were applied to the respective plots prior to working down for drawing drills. The varieties of swedes used were those usually grown by the farmers, and included Tipperary, Monument, Great Scot, Edmondson's Jubilee, and Garton's White-fleshed. The results in all nine trials, under different conditions of boron deficiency and swede variety, are summarized and averaged:—

Roots	Control		Basic Slag		Boronated Basic Slag		Borax 20 lb /ac.		Borax 10 lb /ac.		Boronite	
	%	Av. %	%	Av. %	%	Av. %	%	Av. %	%	Av. %	%	Av. %
Sound	—	33	—	31	—	88	—	91	—	78	—	79
Affected	54–90	67	58–90	69	10–18	12	7–19	9	1–32	22	9–37	21
Bad ..	43–71	51	50–86	59	4–10	5	0–6	4	1–17	11	2–8	5

It is evident that the percentage of badly affected roots was reduced from 51 to 4 or 5 by appropriate treatment.

Basic slag increased the number of affected roots to more than on control plots receiving turnip fertilizer; this is attributed to the action of the lime content as explained on p. 1237. Where it is desired to use slag for the root crop, boronated basic slag should be chosen when the land is known to cause Brown Heart.

Boronated basic slag is the same as the foregoing but with 1.25 per cent. of borax incorporated mechanically. It was used at 12½ cwt. per acre, so giving 17½ lb. borax; this quantity apparently sufficed to remedy the soil deficiency and to counteract the contained lime, the results being nearly equal to those with 20 lb. borax.

Borax was mixed intimately with dry sand, the mixture being spread at the rate of 56 lb. per acre; for easier and safer distribution 1 cwt. is necessary in practice. At 10 lb. per acre there was not sufficient borax to remedy the soil deficiency; at 20 lb. the control was almost perfect.

Boronite, containing 17.85 per cent. borax, applied at 1 cwt.

per acre supplies approximately 20 lb. borax; this dressing gave very satisfactory results.

In one trial included in the above averages the treatments were less satisfactory; this soil was a gravelly, heavy loam, of high acidity (pH.5.45), limed at 1 ton per acre on the ploughed stubble preceding the root crop; previously old (neglected) pasture.

Roots	Control	Basic Slag	Boronated Basic Slag	Borax 20 lb./ac.	Borax 10 lb./ac.	Boronite
	%	%	%	%	%	%
Affected	90	73	28	19	32	37
Bad ..	63	54	8	6	10	7

Although the recent liming may have had some adverse influence on the efficacy of the dressings, it would appear that slightly heavier corrective dressings would have been advantageous here.

In general, application of 20 lb. of borax per acre, or its equivalent in other substances, gives satisfactory results in Cumberland and Westmorland. This agrees with the findings in south-west Scotland,[3] but in North Wales 10 lb. of borax proved sufficient and 20 lb. gave no appreciable improvement on this.[3]

Methods and Costs. Borax (£1 per cwt.) costs less than 4*s*. per acre. There is, however, the labour of mixing it with a carrier—sand or fine soil are suggested, but the writers recommend North African phosphate. Brown Heart was eliminated on one farm by 20 lb. borax with 1 cwt. phosphate, put on with a manure distributor at a rate which worked out at 15 lb. borax per acre. For such home mixing the borax must be powdery (some grades are "cakey"), the carrier must be perfectly dry, and the mixing thorough. In one instance a farmer mixed borax with sand from the farm sand pit, supposedly, but not actually, dry, in which the borax remained in small coherent globules; this faulty dressing reduced the stand of plants by one half.

Alternative treatment to avoid home mixing is by proprietary articles such as boronated basic slag, or Boronite. Boronated basic slag costs 5*s*. per ton more than ordinary slag, so when used at 10 to 14 cwt. per acre (containing 14 to 20 lb. borax respectively) the cost of treatment with the contained

borax is 2*s.* 6*d.* to 3*s.* 6*d.* per acre. Boronite would be used as an extra when the fertilizer scheme provides only for use of superphosphate or ordinary "turnip manure." The borax is incorporated with a filler so that the dressing can be applied easily and uniformly from a manure distributor. Its cost is 11*s.* per cwt.

There are now on the market turnip fertilizers containing borax, their purpose being to save the labour of applying a separate dressing. To be satisfactory in practice such mixtures should meet the needs of individual farmers, so that one using 4 cwt. should be giving as much borax as one using 8 cwt. If one mixture be supplied to all, some farmers will not get satisfactory control of the disease, whilst others may damage the crop. A farmer must not himself mix borax in a turnip fertilizer; in a factory the mixing is done before sulphate of ammonia is added.

All the above-mentioned dressings, including turnip fertilizers with borax, should be applied during the preliminary cultivations, not on the drills, so as to get good distribution in the soil.

Varietal Differences. In general, purple-topped types suffer more severely from Brown Heart than green-topped types under similar conditions of boron deficiency. Variety trials have not been made in this district, but the following results admit of comparisons. The figures give the percentage of bad roots for sets of two varieties growing side by side.

Best of All	Tipperary	Bd Jubilee	Monument	Garton's White-fleshed	Great Scot	Britannia
50	42					
	27	0				
		12	26			
			50	10		
					57	65

The green or bronze-green types, Jubilee and Garton's White-fleshed, showed much less damage than the neighbouring purple types, but even green types suffer considerably where boron deficiency is great, as shown by the figure for Great Scot. Elsewhere Bangholm, Elephant, Magnificent, and Monarch have been reported as varieties badly affected. That the yellow and white hybrids and the common turnip suffer less than swedes is probably due to their difference in boron requirements.

It is not proposed to carry out variety trials, since it is not suggested that farmers base their choice of variety on relative resistance to Brown Heart. It seems preferable from every point of view to apply a corrective soil dressing, and be able to grow any varieties which best meet their requirements in other respects.

Influence of Dung and Lime. In the early investigations of Brown Heart of swedes it was found that heavy dressings of dung (30 tons upwards according to soil) prevented the disease, and heavy dressings of lime aggravated it. In the light of present knowledge it is possible to suggest the probable explanations for these facts, and for the apparent increase of the disease in recent years. Dung, being of very complex composition, would supply the very small amounts of the "minor" elements, such as boron, which would ordinarily be present in normal soils. The diminished use of dung together with the greater chemical purity of artificial fertilizers in recent years, has resulted in a gradual reduction of the amount of boron in the soil, with consequent increase of Brown Heart and the allied Heart Rot of mangolds and beet.

Lime has the effect of rendering boron compounds in the soil unavailable to plants, probably by a combination of chemical and biological reactions. This is now considered to be the reason, or one reason, for the negative effect of liming some soils, referred to as "over-liming injury," and hitherto inexplicable. That liming tends to accentuate boron deficiency diseases of sugar-beet and mangold is now generally recognized where these crops are largely grown. That the same applies to Brown Heart of swedes is indicated by the following results of a trial in Cumberland in 1937:—

Roots	Control %	Basic Slag %	Boronated Basic Slag %	Borax 20 lb./ac. %	Borax 10 lb./ac. %	Boronite %
Affected	76	90	66	35	45	39
Bad ..	65	64	53	14	19	13

Soil medium loam; tanyard waste lime ploughed in on the stubble at about 12 tons per acre in 1931; pH. 7·3 in 1937; Brown Heart had occurred on this land in 1932 severely, cause then unknown.

After the heavy liming, borax at 20 lb. per acre was insufficient, although beneficial, basic slag (stated by the makers

to contain 40-50 per cent. lime) increased the amount of disease, and the borax in the boronated basic slag was almost ineffective. As all the field had been limed there was no check plot to show with certainty that the failure of the treatments was due to liming, but this appears to be a reasonable assumption in view of results of nine similar trials in 1938.

That a soil is of acid type is no guarantee that lime applied to it will be at once neutralized and have no effect on the boron content. The neutralization of soil acidity by lime may take as long as three years, and in the meantime the lime may induce Brown Heart, or increase its amount or severity where it already occurs. The conclusion is that where Brown Heart occurs, however slightly, liming should be followed by a boron corrective for the root crop, and where the liming is heavy, for such purpose as control of Club Root disease, the borax application should be correspondingly heavier, possibly up to 30 lb. per acre.

It will be noted that boron deficiency may be due to either of two causes: a particular soil may have a natural deficiency, or there may be an " induced deficiency " following application of lime, the latter being only temporary as a rule. In either case the deficiency and resulting disease would be accentuated by a dry season, or to be more exact, by a dry summer. Thus it is not always a question of an actual shortage of boron in the soil only, but also of the accessory factors of liming and high alkalinity, seasonal rainfall, and water-holding capacity of a soil.

Boron-deficient Soils. Boron-deficient soils, as indicated by the occurrence of Brown Heart in swedes, extend down the west side of the country, as previously mentioned; and, as indicated by Heart Rot in sugar-beet and mangold, in parts of the east and south. The preponderence of Brown Heart in the west and of Heart Rot in the east may be explained on the following basis. Brown Heart occurs more frequently on acid soils than does Heart Rot; where the different crops are grown side by side the swedes may be much diseased whilst beet or mangold are quite healthy.[5] In general, the western soils are of acid reaction and the eastern soils slightly alkaline, hence the prevalence of the different diseases in the respective districts. However, Heart Rot does sometimes occur to a slight extent on even an acid soil, as shown by a sugar-beet crop on a soil of pH.6.2 having 1 per cent of Heart Rot.[4]

Although Brown Heart occurs on widely different types of soils, from sandy loams to clays, it is most frequent on soils of lighter nature. In Cumberland and Westmorland it occurs mainly on gravelly soils of glacial drift origin irrespective of the underlying strata, whether igneous, sandstone or limestone. These soils are free draining, highly leached by heavy rainfall, and more or less acid. The reaction of the soils in the field trials previously discussed ranged from pH.5.45 (requirement 3 tons $CaCO_3$) to pH.6.82 (requirement ¾ ton $CaCO_3$). These boron-deficient soils are not necessarily adjacent to each other in any given district, nor on any one farm. Even in a single field variations in deficiency may be well marked, affected roots being found in strips or patches; as a rule, deficiency is most marked on the crests in undulating fields, the troughs ("slacks") being less or not at all deficient. Hence, boron dressings cannot be recommended for general application on any farm, much less in any area. The observant farmer is the best judge as to the need for special dressings on particular fields. Whether or not application will be needed in every rotation in future will not be known until further investigations have been completed.

Recommendations. (1) In view of the increased use of lime and basic slag under the Land Fertility Scheme, farmers are advised to examine roots for Brown Heart. (2) If this trouble has been known to occur on a field, borax dressings should be applied for the root crop; this is still more necessary if the field has been limed recently. (3) When in doubt as to the nature of disease in roots, or the advisability of applying borax treatment, consult the County Organizer and get free advice. (4) These recommendations apply also where mangold or sugar-beet suffer from Heart-Rot.

ACKNOWLEDGMENTS. Thanks are tendered to the Principal, Cumberland and Westmorland Farm School for assistance with field arrangements; and to Dr. Greenhill, Boron Agricultural Bureau, London, for use of literature.

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THE PRODUCTION OF VIOLETS FOR MARKET IN THE WEST COUNTRY

Miss K. H. Johnstone,
Ministry of Agriculture and Fisheries

Cornwall. Fifty years ago, violets were being grown for market on a small scale in the mixed market garden holdings in the neighbourhood of Gulval, near Penzance. The industry does not seem to have become of notable size until the 'eighties, but by the turn of the century* substantial quantities were being sent to Covent Garden. This industry seems to have replaced one that previously flourished in the London and Middlesex market gardens, where violets were extensively grown until, beginning in the 'seventies, a decline set in. During the first two decades of the present century the Cornish industry reached its heyday, and violets became an important crop not only at Gulval and the adjoining parishes, but at Lamorna, Mousehole and Newlyn on the west side of Mount's Bay, at Lelant, and at Perranuthnoe on the east side. Meanwhile, new centres of production became established, at Mylor in the Fal valley, where violet growing was started in the 'nineties, and nearby at Feock, where growing began in 1903. Both these are now important violet-growing centres.

Devon. Violet growing is believed to have been started 40 years ago by a Starcross farmer who grew a few violets as a sideline. Returns proved remunerative and a rapid extension took place. Violets are now an important industry; the main area of production is along the south coast from Starcross to Teignmouth; substantial quantities are also grown in the Topsham and Exeter district and a few at Crediton and around Ottery St. Mary.

Size of Holdings. Violets are essentially a crop for the intensive cultivator and are not, as a rule, produced on a large scale. The growers are chiefly flower-growing specialists, although in West Cornwall they may also include broccoli and early potatoes in their rotations. Probably the largest area worked on a single farm is 5½ acres; 1-2 acres is the average amount that growers find they can conveniently handle. Many have much smaller plots, such as some Devon allotment holders who crop ¼ acre or less. Owing to these

* Victoria History of the Counties of England. A History of Cornwall, Vol. I. 1906.

numerous small plots the total area is very difficult to estimate. Perhaps the area in Cornwall might be estimated at 60 to 70 acres, made up of 30-35 acres in the Penzance Peninsula, 15 acres at Mylor, 8 acres at Feock, with scattered plots in various isolated places. About 50 acres are cropped with violets in the Dawlish (south-west) area of Devon and 5-10 acres in the Exeter district.

The vagaries of fashion, the introduction of new varieties, the inroads of pests and foreign competition have all played their part in the ups and downs of the violet-growers' fortunes during the half century under review.

Violets are never entirely out of favour, but posies of violets were in especially great demand up to and during the Great War, since when their popularity has declined, although some revival of demand during the last two seasons has occurred.

Varieties. The violets cultivated in the open air are the large single varieties of *Viola odorata*.

In the early days of the West Country violet-growing industry the variety Czar was widely grown. This was raised and introduced by Thomas Ware in the early 'seventies. In the 'nineties, Princess of Wales was introduced from France, and this quickly superseded the Czar owing to the fine quality of its flowers borne on long stems. This variety remains until to-day the pre-eminent market violet.

Some controversy ranges round Governor Herrick, a variety which became popular with growers during the ten years preceding 1937. In the Gulval district in particular the violet beds had been decimated by attacks of Red Spider, and Governor Herrick, which was very vigorous and resistant to Red Spider, was hailed as the violet-growers' salvation. It has, however, the very serious defect of lack of scent, and the falling off of demand for violets was, in 1937, attributed by some people to the increased production of this scentless variety. To remedy this, an advertising campaign and medallion scheme was started in favour of the scented Princess of Wales. The demand for scented violets is said to have increased; the scentless are certainly now less in request in Covent Garden, though they are still regarded as useful by some and can be used by florists for making up wreaths. Governor Herrick is, however, very prolific, especially towards the end of the season, when Princess of Wales is becoming shorter in the stem.

Cultivation. The violet-growers' year starts in March, or

earlier, when the land is prepared for planting. In West Cornwall, violets are often planted after broccoli, the heavy manuring of which leaves the land suitably fertile. In Devon, violets are often grown after anemones, the third crop in this rotation being polyanthus or carnations of the Allwoodii type. Violets may also follow early potatoes.

A sheltered site is selected and one that receives some light shade is often preferred. Soil moisture is important; this and the risk of the soil drying out in the summer must be safeguarded, hence the importance of a plentiful supply of organic material (humus) in the soil. Where the land has to be manured expressly for the violets, dung may be ploughed in well below the plants at the rate of 20 tons or more per acre, or organic fertilizers, such as hoof and horn, shoddy or bone meal, supplemented by sulphate of potash, may be used. Inorganic fertilizers are used extensively in Devon.

The month of April is the normal planting time and the usual showery weather provides suitable conditions. Violets are usually propagated from runners. It is important to choose short, sturdy runners as these will make a compact crown; the long, straggling "strings" are not suitable. An alternative method of propagation is by the division of old plants. Correct planting is essential; the runners must be firmly set with the crown just level with the soil, neither buried nor standing above the surface. A spacing of 18 in. between the rows and 15 in. from plant to plant in the row is usual. It is not desirable to leave violets down for more than one year, though some growers keep a two-year-old bed as a source of leaves.

Considerable attention is required by the plants during the summer months. First, the beds must be kept clean by hand-hoeing; they may have to be gone over as often as eight times during the growing season. Care is necessary to avoid injury to the roots, which are near the surface, and after June a mere pricking over the soil is desirable. Secondly, the runners formed by each plant should be removed to conserve its energy and so promote development of the central crown. De-runnering, or "stringing," is carried out three times or more during the summer. The runners are severed with a knife close to the crown or, more commonly, pulled away by hand. Some growers heel in these runners and later select for planting out those that will form satisfactory crowns.

The chief anxiety during the summer, especially if it is a

dry season, is the possibility of attacks of Red Spider. Affected leaves turn yellowish and minute red specks, revealing the presence of the pest, are seen on the under surface. When weather conditions favour its increase the pest is difficult to deal with, but some growers control it by spraying with white oil emulsion, which is a somewhat expensive method. The pest can be checked to some extent by the use of sulphur dusts (which are also successfully used as a preventative) or by stripping off all the leaves; the crowns form clean new leaves again later.

The aim of the grower should be to secure a steady growth and development of his plants. A top dressing of sulphate of ammonia or nitrochalk is often given if the plants appear to require it.*

Picking. During October, or sometimes September, flowering commences and should continue until the following April. Picking violets is "back breaking" work, and an extra bonus is often demanded for workers employed exclusively in this occupation. Normally, two workers are almost continuously occupied during the flowering season in picking the violets from one acre. The flowers are taken to the packing shed for grading and bunching by women who, in the West Country, attain a high degree of dexterity in making up the bunches. A good worker can make 35 or more large bunches (each of 36 flowers) per hour. For an acre of violets, 2 girls would be employed for bunching; on many holdings, however, this work is done by members of the family.

There is no standard violet bunch; growers usually inquire of their salesmen and are advised according to the demand or requirements of their customers. The large bunch of 36 flowers surrounded by 5 leaves is perhaps the most in demand. Small bunches of 18 flowers with 3 leaves at the back are also used, and these are sometimes put together in groups of three bunches. Very large bunches of about 50 flowers are occasionally made, but are only possible with long-stemmed flowers. The bunches are usually tied with raffia, using long, twisted tie, starting beneath the leaves and ending near the

* Full details of cultivation methods will be found in the following two useful publications:—*Violet Culture for Pleasure and Profit*, F. E. Dillistone (London, Ernest Benn Ltd.), and *Commercial Violet Production*, H. W. Abbiss (Truro, Cornwall Education Committee).

ends of the stems. Rubber rings are used, but to a smaller extent, as they are apt to cut into the stems.

The bunches, supported by wire netting, are sometimes placed with the stems in water; dipping the whole bunch in water is usual, but a light spraying with water is perhaps better.

Special violet boxes are made for packing. These measure 16 × 11½ × 3 or 3½ in. and hold 4½-doz. bunches of 18 flowers or larger bunches. Large bunches are sometimes packed in "Sol" boxes (23 × 11½ × 4 in.): these hold 3-doz. bunches. Careful interlacing of the stems keeps the bunches sufficiently secure. About 70 boxes of flowers per acre are secured each week during mild weather and up to 200 or more during the spring glut.

During cold weather, various troubles assail the violet grower. When the temperature falls below 40°F. the flowers do not open, and violets must be properly open when picked as, unlike many other flowers, such as daffodils, they cannot be satisfactorily opened in water from the half-opened bud. Some growers enclose the plants in a temporary frame with hessian nailed to the back so that it can be drawn over the plants during frosty weather or when cold winds are blowing. Another winter trouble is scarcity of leaves. Several of the best growers have a special bed, often of plants left down for a second year, from which to take leaves. Also commonly used are the leaves of the winter heliotrope (*Petasites fragrans* Presl.), which grows profusely as a weed in Cornwall. Salesmen state, however, that buyers from the West-End London shops regard the use of these leaves as an indication of poor quality, and in consequence the violets are purchased only by the cheaper shops and hawkers.

Aphis also damages the flowers of violets, especially during cold weather and in certain seasons, causing malformation of the blossoms and colourless spots. If possible, this pest is checked before flower production begins by stripping the leaves and spraying with nicotine wash, as once flowering has commenced spraying is undesirable.

By April the flowers have usually lost colour and are shorter stemmed; picking then ceases. By this time a yield of 20,000 large bunches per acre, or up to 30,000 in favourable seasons, should have been obtained.

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BRITISH COD-LIVER OIL: ITS PRODUCTION, PROPERTIES AND USES AS A FEEDING STUFF

K. MacLennan

Within the last decade British cod-liver oil has become not only a firmly-established feeding stuff in ordinary, and especially in intensive, livestock farming, but also an important source of additional revenue to our fisheries. Incidentally, a substantial export trade in both medicinal and feeding cod-liver oil has developed to all parts of the world. British cod-liver oil, in fact, has become one of the few home-produced foodstuffs which this country exports in substantial amounts.

Production. There has recently been a complete revolution in production methods. British long-distance trawlers now follow the cod to his every haunt in the Polar and Sub-Polar seas every day of the year.

The development of this long-distance fishing made for difficulties in cod-liver oil production, which have only recently been fully overcome. Fish livers are, from their nature, extremely perishable. Their tendency to decompose, by bacterial action, by virtue of the enzymes with which the organ is abundantly supplied, or merely by oxidation and splitting of the oil, is so pronounced that no effective steps to preserve livers as such are possible or feasible. Both ice storage and refrigeration are ineffective. Inferior oil only can be obtained from livers preserved by these means.

The solution of the difficulty has been found in rendering the oil from the livers at sea. Fortunately, with fish of the cod family this is comparatively easy. Prime livers may contain as much as 80 per cent. of oil, while even "dry" livers, according to my information, seldom sink as low as 40 per cent. A simple boiling with open steam is, therefore, all that is necessary to separate the oil from the liver tissue, and as a matter of practice it is found that both the oil and the residue prepared carefully in this way keep perfectly if stored in clean, cool containers until the vessel returns to port. The steaming process is effective in eliminating the inherent tendency of the liver to decompose and is essentially the technical change which has made the modern British cod-liver oil industry.

Prior to the introduction of sea rendering, oil from British fisheries was a foul, evil-smelling liquid of a colour varying from port wine to ruby or even black. It was used mainly for the cheaper industrial purposes, such as leather dressing and the manufacture of dubbin, lubricating greases, disinfectants, and low-grade soaps. It was marketed either as technical cod-liver oil, if from the livers of fish of the cod family, or as Coast-cod oil if from mixed livers, and the bulk of it went for export.

The modern cod-liver oil made by sea rendering is by contrast and in fact an attractive food oil without offence to nose or palate. Its taste can best be described as reminscent of the sea and its freshness—a delicate oyster-like flavour—a fondness for which can readily be acquired. Few people, in fact, realize how helpful their noses and palates can be to them in gauging the amount of effective care that has been taken to ensure reasonable quality in the cod-liver oil they are offered for medicinal purposes or for their live stock. Oils that repel should be avoided, for the oil as it exists in the liver of the live fish certainly has no repellent character. Offensiveness is a thing which arises solely from defective handling and failure to appreciate the inherently delicate character of the oil as a food oil.

The change in production methods has been accompanied by a spectacular rise in production. The total production of technical cod-liver and coast-cod oil in this country used to amount to approximately 7,000 tons per annum. In the current year, production may possibly reach 16,000 tons. Most of this is sea boiled and goes for medicinal or feed purposes. Oil production is centred at the four main fishing ports—Hull, Grimsby, Aberdeen and Fleetwood.

Processing. Sea-rendered cod-liver oil needs care in handling, but nothing of a complicated nature in the way of processing. On board ship, to get the best results, the oil, after rendering, is stored in special containers built against the skin of the ship so that the oil cools rapidly in the Polar seas. On shore, purification by washing, and subsequent treatment either in centrifugal separators or under high vacuum are the normal processes. Either process should result in oil which is clear, bright, and free from moisture or sediment. It should be no deeper in colour than light straw and the oil should be free from all offensive smell or taste.

The remaining processing is confined to blending to secure uniformity of quality and vitamin values and to cold clearing for medicinal oil to remove that fraction of the oil which solidifies at freezing point. This is an aesthetic refinement which is neither necessary nor desirable for feed oils.

Until the oil is finally sealed in the marketing bottle or container, meticulous care is necessary to prevent oxidation from undue contact with air. Badly oxidized oil has a varnish or dubbin-like smell, gives a burning after-taste in the mouth, and, if swallowed, a similar sensation in the stomach. Such oils should be avoided for edible, medicinal or feeding purposes.

Vitamin Values. Special attention should be given to the vitamin values of cod-liver oil. These were defined in the *British Pharmacopoeia* for the first time in 1936, as not less than 600 Units of vitamin A activity, and not less than 85 Units of antirachitic activity (vitamin D) in 1 grm. The figure of 600 International Units of vitamin A is low for average cod-liver oil, but that of 85 Units of vitamin D per grm. is higher than many undoubtedly genuine cod-liver oils can show. The point to stress is that even at the minimum values which genuine cod-liver oil can show, it will always do its work medicinally or as a food oil when used in the quantities and proportions usually fed or prescribed. A desirable minimum standard would be 500 Units vitamin A and 50 Units vitamin D per grm.

The vitamin values of cod-liver oils, and, indeed, of all liver oils, vary within wide limits. For genuine cod-liver oil, extreme figures on upwards of 30,000 tons of oil examined in batches of from 50 to 250 tons are from 5,000 to 500 Units of vitamin A and from 500 to 50 Units of vitamin D per grm.

Adulteration. Cod-liver oil has, by virtue of its outstanding nutritive values, always commanded market prices higher than most other fish oils. It is also an oil in which adulteration is somewhat difficult to detect and prove. The usual forms of adulteration are:—

1. Admixture with other fish or marine oils superficially resembling cod-liver oil.
2. The addition of Vitamins A and D from other sources.

Either type of adulteration is somewhat difficult and expensive but by no means impossible of detection, but when both types of adulteration, skillfully done, occur at the same time,

the puzzle set for the chemist or biologist may be all but impossible of solution.

Adulterated cod-liver oil can be very disastrous in practice and can at best only lead to exaggerated estimates of the amount of oil or vitamins it is necessary to use in feeding practice.

Fortunately, in British farming, adulterated cod-liver oil can be easily and certainly avoided. Production is centred at very few ports, and reliable oil sealed at its source and of guaranteed purity, quality and vitamin values can readily be obtained from the primary producers, most of whom are themselves in a position to obtain or carry out adequate biological tests. This is by far the best precaution to observe in buying, but it is always well to obtain a specific invoice or other guarantee to the effect that the oil is "guaranteed to be pure cod-liver oil from which no constituent has been removed and to which nothing has been added." Such a specific guarantee coupled with the evidence of general quality which the farmer's own nose and palate can give him is really all that is necessary in buying cod-liver oil for his live stock.

Stability. Cod-liver oil is not entirely stable either in its character as an oil or in its vitamin values. Care in handling and use is therefore necessary. The main thing to be guarded against is the oxidation changes which can readily take place when the oil is exposed freely to air. In closed and sealed containers, cod-liver oil retains its food quality and vitamin values intact almost indefinitely, but once containers have been opened and especially if there is free access of air there is danger of deterioration. Even then, however, deterioration is not rapid, especially if the oil in the first instance has been of good undamaged quality. It is a good rule to buy oil in new sealed containers and in such amounts that the contents are used up within a reasonable period of the date of opening. Should this not be possible, the contents of large containers should be transferred to clean small ones and be sealed up to await use.

The greatest danger from oxidation changes arises after the oil has been mixed with feeding meals and stored for prolonged periods. Unfortunately, no definite period of safety can be given under this heading since so much of the stability of the mixture depends on the quality of the oil itself, the quality of the meals and the method of incorporation

employed. Damaged oils themselves go off more quickly but even more important is the quality of the meals. Meals which are in any way old or musty are particularly destructive to the added oil—a further reason, if any were needed, why such meals should be rigidly avoided for feeding purposes.

The method of incorporation is also of importance, and probably the best method and the one followed by the most reliable feed manufacturers is to mix and steam the meal gently to begin with so as to break up any loosely bound oxygen complexes in it. Such procedure also improves the general feeding quality of the meal. Admixture of the oil may then be carried out practically in an atmosphere of steam and at such temperatures as will ensure penetration of the oil into the particles of the meal and some consequent protection from the air.

Taking all circumstances into account, the method of choice in feeding should be for the farmer to use and mix the oil on the farm for immediate consumption. In this way he can be sure of the full feeding value of oil and vitamins, and avoid all deterioration.

Use as a Feeding Stuff. Cod-liver oil is the only fat used as such in the feeding of animals. Its value in feeding arises out of this and out of the fact that it is outstandingly rich in the two fat-soluble vitamins A and D.

FEEDING VALUE. As a pure digestible fat 1 lb. of cod-liver oil has as much energy value as 2.3 lb. of pure starch. It also takes 4 lb. of starch to give 1 lb. of fat in the animal body, and it is known that an adequate amount of fat is necessary for the complete and satisfactory digestion and assimilation of starchy foods. Each pound of good cod-liver oil fed should result in an economy of some 3½ lb. of mixed feed of starch equivalent 65/70. The complete food value per ton of the known constituents of cod-liver oil in terms of its starch equivalent and vitamin A and D values may be assessed as under:—

		£	s.	d.
Value of starch equivalent, £8 × 3½	=	28	0	0
Value* of Vitamin A—1,000 million units @ 6*d*.	=	25	0	0
Value* of Vitamin D—100 million units @ 2*s*.	-	10	0	0
Food and Vitamin Value per ton		£63		

* Values for oil containing 1,000 International Units of Vitamin A and 100 International Units of Vitamin D per grm.

Reliable cod-liver oil can usually be purchased at prices very much below this figure and, used with discretion, is a good value for money feed.

Methods of Use. Despite its high food and vitamin value per ton, cod-liver oil is an expensive food stuff and its use should be systematically and carefully restricted to those classes of live stock and sets of conditions where an economic return can be confidently looked for. These, generally, are:—

1. For pregnant and lactating animals.
2. For young, rapidly growing live stock.
3. For stock kept intensively and fed a diet predominantly of concentrated starch rich foods.
4. As a supplementary winter time food.

Obviously, most of the above conditions apply to either or both poultry and pig keeping, and particularly to young and breeding stock. They also apply to calf rearing when this is done artificially. For other classes of live stock, cows, horses and sheep, cod-liver oil should be regarded as something to be used in pregnancy, lactation and youth in winter time or when pastures are scorched and bare. In these circumstances, cod-liver oil can make good in great measure the difference in feeding value between the rich young grass of spring and early summer and the predominantly vitamin-poor, even vitamin-free, foods of winter or hand feeding.

Taking the ordinary classes of farm live stock in greater detail, the following are general recommendations:—

Poultry. Even the best mixtures of ordinary farm foods, made up from cereals, milling offals, fish meal, meat meal, yeast and mineral supplements, contain insufficient vitamin A and D values to keep birds in health and heavy production under intensive conditions as sufficient sunlight is not always available, and a further supplement, such as cod-liver oil, is therefore desirable. Nothing but disaster results with intensively kept day-old chicks if such a supplement is omitted. The whole tendency of modern poultry keeping has been to push the breeding and egg-laying season back from spring and early summer to winter and early spring. In view of this it is practically impossible for the birds to obtain even from natural surroundings all the vitamin A and D values that are now known to be essential for growth and for heavy egg production. Cod-liver oil presents an easy way of overcoming this difficulty.

For classes of poultry other than hens, and particularly for day-old turkeys and ducks, there is even greater need for cod-liver oil. Symptoms of deficiency which require some 5 to 6 weeks to develop with chicks fed on ordinary mixtures of farm foods without cod-liver oil develop, under the same conditions, with day-old ducks and turkeys within two to three weeks.

For average conditions the amount of reliable cod-liver oil necessary for poultry is 1 pint per cwt. of food fed, including both mash and grain. It can be mixed with either the mash or the grain or both, and should preferably be fed as soon after mixing as possible.

Pigs. The food fed to pigs is essentially of the same nature as the food fed to poultry; that is, predominantly rich in starchy matter and predominantly poor in good-quality fat and the fat-soluble vitamins A and D.

Further than this, pig keeping is tending to follow the same sort of intensive lines as poultry keeping and the same type of nutritional failures are liable to occur (see this JOURNAL, December, 1938).

For pigs, the best results with cod-liver oil will be got from the breeding, suckling and weaning animals. Breeding failures, particularly in the winter time, are often due to failure to use cod-liver oil in the food, and the same cause often accounts for failure in lactation and for lack of vigour and vitality in the weaned pigs.

The amount of 1 pint per cwt. of food fed is satisfactory for breeding, young, and weaning stock. Its use for pigs that have been firmly established after weaning requires greater caution and should not be necessary if the oil has been given systematically through pregnancy and lactation. Store pigs whose vitality has been built up satisfactorily can usually stand up to the necessary fattening period on the strictest quality feeds from a bacon production point of view. The use of large quantities of poor quality cod-liver oil during the fattening period should be avoided as there is otherwise a distinct danger of undesirable taint or rancidity arising in the cured bacon.

Horses. Horses, like pigs and poultry, are not suited by the nature of their digestive mechanism to obtain sufficient nourishment from grass to meet all their needs for long periods of work or training. Hence, they must be "put out to grass" more or less frequently, depending on the manner

of feeding, to make good the constitutional impairment that invariably arises from the ordinary mixtures of hand-fed food. With working horses the periods over which they can be kept in hard work without being turned out to grass can be very much increased by the systematic use of cod-liver oil with stall-fed rations. The same is also true for horses in training.

There is also considerable evidence to show that the difficulties which arise in breeding of bloodstock, pedigree horses, and with working animals under town conditions, arise from failure to give sufficient attention to adequate supplies of vitamins A and D in the food fed. Deficiency of this kind can most easily and economically be made good by the systematic use of cod-liver oil.

An amount of cod-liver oil equivalent to 1 pint per cwt. of food is again suitable for horses. If the hay fed is of really good quality this amount may be calculated on the amount of grain and concentrates fed. It may be given mixed with the food in the ordinary way or, alternatively, the old custom of giving a special bran mash containing the necessary amount of oil may be given once or twice a week. This is of particular importance for brood mares where difficulties have arisen in breeding, and in the health and vitality of foals.

Cattle. The outstanding difference between cattle and the other classes of live stock already considered is that they, like sheep and goats, are herbivorous animals with a complex digestive system intended by nature to deal satisfactorily, for the needs of the animals, with large quantities of grass. An outstanding difference between grass, the natural food of herbivorous animals, and the food which these animals are normally offered, is the abundant vitamin value, particularly vitamin A, which grass supplies as compared with the normal indoor hand-fed food. Milk cows require much larger supplies of vitamin A for their wellbeing and for the production of milk of satisfactory quality than are contained in the ordinary foods fed indoors. In many instances, indeed, it can be said that this food is almost entirely devoid of vitamin A value. It is well known that milk cows will denude their own bodies to provide milk of reasonable quality; as much as one-half of their bone substance can be sacrificed for this purpose, and the same is apparently true of their reserves of vitamin A. Such deprivation contributes substantially to the high rate of wastage which characterizes our dairy herds and to the failure

to breed successfully and to produce healthy, vigorous calves, which is another and very disturbing feature of intensive milk production. Another point is that with dairy cows, as with poultry, there is, for a variety of commercial reasons, a strong motive to concentrate the high production period in the winter months when the foods available are predominantly poor in vitamin values. The poor vitamin quality of winter milk reflects the winter vitamin poverty of the food fed.

For calves and young growing stock, particularly when these are kept indoors and hand-reared, there is every reason to supplement the skim milk and ordinary mixtures of food with cod-liver oil; in fact, the condition of calves and store cattle during their first or even second winter is often eloquent of vitamin starvation during the winter months, and the spectacular improvement which can take place when such animals are turned out to good, luscious spring grass is equally eloquent testimony to what can be, with confidence, attributed in great measure to the making good of this vitamin deficiency.

The quantity of 1 pint per cwt. of concentrate food, consumed is suitable both for mature and young stock. With cows, care is necessary in introducing the oil into the food, and it is specially important that cod-liver oil of poor quality, repellent in taste and smell, should be avoided; otherwise, digestive disturbances may arise and there may be interference with milk and milk-fat secretion. Such results have been observed in practice when excessive amounts (up to 6 pints per cwt.) of questionable cod-liver oil have been used. On the other hand, there is evidence to the effect that when good quality oil is used in reasonable proportions (up to 1 pint per cwt. of food) the effect on the health of the animal, on its milk and milk fat secretion, and on the vitamin value of the milk is beneficial.

For hand-reared calves, the amount of cod-liver oil necessary to supplement skim milk and give a reasonable amount of fat as well as the necessary vitamin values is about 2 ounces per gallon of skim milk. Good quality cod-liver oil only should be used and it should be mixed or emulsified as thoroughly as possible with the milk before feeding. When dry feeding is introduced, the normal allowance of 1 pint of cod-liver oil per cwt. of feed is satisfactory.

Sheep. Much attention has been given to the mineral deficiencies of sheep pastures in this country and elsewhere, and it is known that mineral deficiencies can have disastrous

effects on the wellbeing, and particularly the breeding capacity and general health, of flocks. Apparently little attention and study has, however, yet been given to the question of vitamin deficiencies, though it is known that vitamin deficiency itself, especially vitamin D deficiency, can lead to insufficient use of such mineral supplies as may be available. All that can be said on this subject meantime is that many of the symptoms that are prevalent in our flocks, particularly parasitic infestations and failure to produce vigorous lambs, suggest vitamin deficiencies of the type that could be made good by the systematic use of cod-liver oil, particularly when pastures are bare, when flocks are on limited range and where hand-feeding has to be resorted to.

The amount of 1 pint per cwt. already recommended for other classes of live stock is satisfactory for sheep as an addition to the hand-feed given to breeding flocks, ewe lambs intended for breeding purposes, and to young lambs.

Cod-Liver Oil as a Medicine. It is the feeding value and normal use of cod-liver oil as a feeding stuff that has already been stressed. It is much better to use the oil systematically as a food than to use it in emergency as a medicine. Where symptoms of deficiency are actually apparent the amount of cod-liver oil used can be increased from 2 to 4 times the standard allowance of 1 pint per cwt. of food.

In many instances cod-liver oil can be given in substantial quantities from a few ounces to upwards of a pint in one dose, when, in addition to its curative action, it will also act as a mild purge or laxative.

EDITOR'S NOTE. It will be realized that this article has dealt exclusively with cod-liver oil. It is not intended to suggest, however, that other fish-liver oils cannot be advantageously used in animal feeding.

CUTTING WEEDS TO PREVENT SEEDING*

N. T. GILL,

Lecturer in Agricultural Botany, Midland Agricultural College

Everyone would agree that weeds should not be allowed to produce seeds and so to multiply, and it is a common opinion that seed production can be prevented by cutting down the plants before seeds have begun to form. This, however, is not always effective since, as regards certain weeds, even if the plants are only allowed to flower before being cut they appear to mature their seeds after cutting, and it may be that these seeds are capable of germination.

An examination of certain common weeds has shown that, so far as the possibility of production of seeds after the plant has been cut down is concerned, it is quite safe to leave certain species until flowering time, whilst closely related species must be cut even before the flowers are open, that is before the petals have opened and the stamens become visible.

In the botanical family *Compositae*, for example, ragwort (*Senecio Jacobaea* L.) will ripen seed with a high germination capacity if allowed to flower before being cut, whilst dandelions (*Taraxacum vulgare* Schrank) cut when in flower will simply dry up without ripening any seed. Creeping thistle (*Cirsium arvense* Scop), when cut in the flowering condition, appears to produce seed as the plant dries; a large amount of fluffy pappus develops from each flower head and a number of fruits form attached to the fluff. These fruits on being split open, however, are found to be empty. It is therefore doubtful whether much seed capable of germination is produced from plants of this thistle if cut when in flower.

The germination of seeds of common weeds of the family *Compositae* ripened on the plants, compared with that of any

* A detailed account of experimental methods used in obtaining the figures quoted in this paper is contained in a paper by the author—"The viability of weed seeds at various stages of maturity," printed in *The Annals of Applied Biology*, Vol. XXV, No. 3, pp. 447–456, 1938.

seeds produced by plants after cutting in the flowering condition, is shown below:—

	Seeds Ripened on Growing Plant	*Seed from Cut Plant*
Ragwort (*Senecio Jacobaea* L.)	72	80
Sow thistle (*Sonchus oleraceus* L.) ..	100	100
Groundsel (*Senecio vulgaris* L.)	90	35
Dandelion (*Taraxacum vulgare* Schrank.)	91	Nil
Cat's ear (*Hypochaeris radicata* L.) ..	90	,,
Creeping thistle (*Cirsium arvense* Scop.)	38	,,
Spear thistle (*Cirsium lanceolatum* Scop.)	54	,,

Ragwort, sow thistle and groundsel are therefore capable of producing healthy seeds from their cut flowers, but it appears that no seeds capable of germination are produced *if the plants are cut down when the flowers are in bud* although each flower-head produced the usual mass of fluffy pappus. Thus it is unsafe to leave these species to flower and then to cut them down unless the cut plants are removed and destroyed. If cut whilst the flowers are still in bud, however, there is no danger of seeds being produced when the plants are left lying on the ground after cutting.

Dandelion, cat's-ear, creeping thistle and spear thistle, however, do not ripen their seed even if cutting is delayed until the flowers are fully open. It should be emphasized that although the two thistles produce a lot of thistledown, when cut in the flowering condition the fruits attached to the down are empty. In no single instance has the writer succeeded in germinating seeds produced from creeping thistle and spear thistle after the thistles had been cut when in flower. If these thistles are allowed to grow until the petals have withered and the thistledown (the fluffy pappus) begins to extend, then ripe seeds capable of germination are produced as the plants dry. The plants should therefore be cut before the petals die and the thistledown begins to extend.

GRASSES. If cut in the flowering condition, the grasses do not ripen seed on drying. If fertilization has taken place, however, and the grain has started to enlarge, some seed may be produced on drying. Two common weed grasses examined, namely meadow barley grass (*Hordeum nodosum* L.) and soft brome grass (*Bromus mollis* L.), showed that if they were cut when the grains had formed and were present in the milk-ripe condition seeds with a high percentage germination were produced on drying. At this stage of growth the grasses are still green. The percentage figures obtained for

these plants compared with those for seeds ripened on growing plants were:

	Ripened	Milk-ripe
Meadow barley grass	94	90
Soft brome grass	96	81

To prevent the formation of seeds on these species, cutting must take place very early before the seeds have begun to form.

DOCKS. Plants of curled dock (*Rumex crispus* L.) and broad dock (*Rumex obtusifolius* L.) cut in the flowering condition with the stamens still present fail to ripen seeds, but when the plants are allowed to grow until the fruit has enlarged and is present in the milk-ripe condition seeds of high germination capacity are produced when the plants are cut down and allowed to dry in the sun. At this stage of growth the plant is still green and the leaves have not begun to die off. The following percentage figures were obtained from germination tests on seeds of curled dock:—

Seeds ripened on growing plant	84
Plants cut when seeds milk-ripe	88

Docks should therefore be cut very early before the seeds have begun to form in order to prevent the ripening of seed.

COMMON NETTLE. Plants of the common nettle (*Urtica dioica* L.) cut down in the flowering condition before the stigmas wither do not ripen any seed on drying, but plants cut when seed is present in the milk-ripe condition ripen seed of high germination capacity. As with docks, the plants of the common nettle at this stage are still fresh and green. Percentage figures obtained for germination tests of this species were:

Seed ripened on growing plant	77
Plants cut when seeds milk-ripe	70

Again it would appear that very early cutting is advisable, for seeds can be produced on the cut plants even though they appear still young and green on cutting.

Conclusions. To prevent further spreading of ragwort, sow thistle, and groundsel by means of seeds, the plants, if they are to be left to dry after cutting, must be cut down before the flower buds have opened.

Dandelion, cat's ear, creeping thistle and spear thistle may be cut down when in flower and allowed to dry with little danger of any germinative seed being produced.

Soft brome grass, meadow barley grass, docks and common nettles must be cut when still green and before the seeds have begun to form.

MARCH ON THE FARM

R. W. Wheldon,
King's College, Newcastle-upon-Tyne

The comparatively mild and dry weather during the greater part of the past month proved most welcome, as it allowed work on the land, which had been delayed by wet conditions, to progress.

Except on very stiff soils, the land has turned up well and it does not look as if there will be serious difficulty in getting a good seedbed. " Well sown, half grown " is a true saying, and every cultivator likes to see the crop sown under favourable conditions, but, however good the state of the soil and however good the seed, manuring should not be neglected. In these days when cross-cropping is more widely practised and a second corn crop is not uncommon, some expenditure on manures is frequently profitable.

Seeds Mixtures. During this and next month large areas of land will be sown down with seeds mixtures for short and long leys. The quantity of seed required is often a matter of argument, but what really matters is the number of plants finally established. A fine seedbed and proper soil consolidation are very important in securing a good take of grass and clover seeds, particularly the latter.

It is now customary to sow comparatively simple mixtures, in contrast to the complex seedings used 30 or 40 years ago. For a one-year seeds mixture at Cockle Park the following is used:—

Perennial Ryegrass	18 lb.
Late Flowering Red Clover . ..	5 ,,
Dutch White Clover	1 ,,
Trefoil	2 ,,

Under Cockle Park conditions, this usually gives a much greater weight of hay than a mixture containing Italian ryegrass and broad red clover. Italian ryegrass commences growth earlier in the season and tends to overshadow the young clover plants in the spring, thus checking their growth. Although the crop usually appears to be heavy, weighing off proves it to be considerably short of that from a mixture containing perennial ryegrass. While the late-flowering red

clover gives a heavier weight of hay per acre, it is probable that it is more stemmy in character, the hay being rather coarse, and for some classes of stock this may be a disadvantage.

A mixture for a 3-years ley or longer consists of:—

Perennial Ryegrass	16 lb.
Cocksfoot	10
Timothy	4
Late-flowering Red Clover . ..	4
Trefoil	1
Wild White Clover	1½

This mixture, or some modification of it, has been found to do well not only at Cockle Park but over the greater part of the country.

Where it is desired to graze the seeds with ewes and lambs in the first year, it is an advantage to replace some of the perennial ryegrass with Italian ryegrass, so as to provide some early succulent green food. Given suitable management and favourable conditions, the cocksfoot is an important constituent, especially if it is desired to take hay crops frequently. Heavy grazing in early spring tends to weaken cocksfoot, as this plant usually starts away before the others and is readily consumed by stock.

At Cockle Park, on strong clay land, an average of about 37 cwt. of hay was produced annually over a period of 17 years from a mixture of this type, the only manuring being 10 cwt. of high-grade basic slag per acre applied every 3 years. Not only was the amount of hay produced satisfactory, but its quality was excellent. A great deal of attention has been paid to the production of better pasturage, but to reap the full advantage of summer keep it requires the support of correspondingly good winter keep.

The management of hay ground after the hay is removed, the proper grazing of the aftermath, the avoidance of a mat or a too severe plunging in winter by stock, as well as manuring, all need consideration. Although cocksfoot matures earlier than ryegrass in the hay crop, it is still regarded as a valuable plant in the north of England. Not only does it give considerable bulk, but the hay can be won more readily, as the strong flowering stems of the cocksfoot help to maintain an open swath, which is more readily dried under north-of-England conditions. The crop is usually cut before it has

reached maturity, but even at this stage the cocksfoot exerts this desired effect.

Under pasture conditions cocksfoot needs to be properly grazed. Over-grazing tends to weaken it and it succumbs, while if left under-grazed it will dominate the herbage, becoming coarse and unpalatable. It is a grass which is most valuable where the seasonal output does not vary greatly and the stocking can be so arranged as to maintain it in good condition.

Sheep. On lowland and intermediate farms, March is a busy month for the shepherd. Lambs a few weeks old require much attention, as a plentiful and suitable food supply is essential if the advantage of early lambing is to be fully obtained. Favourable weather has been a boon to early lambs this season and they appear to be doing well. Although prices are not promising, and there does not seem to be much encouragement to spend money on concentrates, the withholding of anything necessary to a good milk supply and satisfactory growth will usually be false economy. Some succulent food, such as roots or kale, is most valuable at this season of the year. The dry matter of these foods is digestible and they keep the animals healthy. In this way they help the appetite, an important point with the nursing ewe.

The losses from disease are considerable amongst all classes of sheep. Much research work has been undertaken, the results of which have been of great help in the control of many diseases. The work is still going on and can be greatly helped by the co-operation of flockmasters and shepherds. An excellent example of such co-operation of the landowner, farmer and shepherd is the research work into sheep and lamb disease undertaken by the Management Committee of the Alan, Duke of Northumberland Memorial Fund. The object of the Fund is to commemorate in a useful and practical way the brilliant life and public services of Alan, eighth Duke of Northumberland, who died in 1930. The memorial, opened to public subscription in 1931, takes the form of a foundation to facilitate investigational work into diseases of live stock, with primary reference to the ailments of sheep. The foundation yields approximately £125 annually, and for the remainder of its income the Management Committee is dependent upon annual subscriptions and donations. Research work is undertaken in connexion with " Pregnancy disease

of Ewes (Staggers)," "The Control of Sheep Ticks," "Border Pining," and "The Use of Silage on Hill Farms." The Fifth Report of the Management Committee recently published gives much interesting information and may be obtained from Mr. W. Lyle Stewart, M.R.C.V.S., King's College, Newcastle-upon-Tyne.

Potatoes. Although there may be a measure of truth in the adage "Plant potatoes when you will, they won't grow till April," most growers do not care to miss a favourable opportunity for planting in March. The crop is expensive to grow and the risk of failure should be avoided in every possible way. Great care should be taken to obtain good seed, saved from a vigorous, healthy crop, free from Leaf Roll and Mosaic. These diseases are responsible for serious loss in crops every year. It is not possible to judge from the seed, which may appear perfectly sound, whether it will give rise to diseased plants. Recognizing the importance of healthy seed, the Ministry of Agriculture and the Department of Agriculture for Scotland conduct a system of inspection during the growing-season, and certificates covering both purity and health for crops which reach the necessary standard are issued.

During recent years there has been a tendency to increase the amount of fertilizer applied to this crop. Properly balanced manuring is important if the best results are to be obtained. Farmyard manure helps the physical condition of the soil and is specially valuable on stiff soils by assisting aeration and, on the lighter soils, by helping to retain moisture.

Nitrogen and potash are also important; the former helps the production of the necessary leaf growth and the potash increases the efficiency of the leaf in its work of elaborating the food to be stored in the tuber. It is generally considered that sulphate of potash gives better results than other forms, both as regards weight of crop and quality of tuber. Phosphates are important, but it would appear that this requirement of the crop is easily met on many soils and it is not now customary to use such heavy dressings as previously. A mixture containing by weight 2 parts sulphate of ammonia, 3 parts superphosphate and 2 parts sulphate of potash, is frequently recommended for maincrop potatoes. The amount applied varies with the amount of farmyard manure used, previous manuring and prospect of crop. Where good crops

of 8-12 tons per acre may be expected, liberal applications are recommended.

Tractor row-crop cultivators are now frequently used and on many farms are most useful. A lot of ground can be covered and useful drill cultivations can be repeated often if the weather is favourable, reducing the amount of hand labour and greatly helping soil conditions for the crop.

Roots. Some years ago the general tendency on many farms was to reduce the area devoted to these crops. Concentrated foods were available in quantity and variety, and cattle were found to do well with much-reduced allowances of roots, which were thought to be too expensive and of little value. Their cost depends to a large extent on the weight of crop that can be grown. A good crop—20 tons or more—provides over 2 tons of dry matter per acre, in the form of a useful, palatable, digestible food. This is now being recognized by many farmers and greater consideration is now being given to roots. It is important, however, that they should be grown under favourable conditions, so as to produce a good weight of food per acre. Tilth, suitable variety and liberal manuring are all necessary. Attempts to grow too large areas of roots have frequently resulted in disappointment. It is usually better to concentrate on an area which can be satisfactorily cultivated and manured.

MISCELLANEA

Varieties of Cereals for Spring Sowing

The following brief notes, based on the recommendations of the National Institute of Agricultural Botany, should serve as a guide for this season's spring sowings.

While not encouraging the growing of spring wheat, since it is seldom a profitable crop, the Institute's experience shows that if this practice is followed, the most satisfactory varieties are Little Joss if drilled by the middle of February, Red Marvel or A.1 for the first half of March, and thereafter until the middle of April, April Bearded.

The improvement of varieties in recent years has been particularly marked among spring oats. The Institute recommends Eagle, Star, Onward, Victory, Golden Rain and Golden Rain II, the last two essentially for home consumption, as the small size of their grain and its yellow colour frequently reduce their sale value. Marvellous is recommended for early sowing on good soils, as is Resistance, which also produces high yields when sown early in spring.

In barleys, the Institute restricts its recommendations to the well-known varieties Plumage Archer and Spratt Archer. The "1935" Plumage Archer has given better results than the "1924." Where late sowing cannot be avoided, Svalof Victory or the Danish Kenia and Maja deserve trial.

Whichever variety is chosen, early sowing almost always pays. English-grown seed gives just as good results as imported seed, if the standard of purity and germination is the same.

In connexion with this subject, the Institute has published two Farmers Leaflets, No. 2, *Varieties of Cereals for Spring Sowing,* and No. 7, *Choice of Seed,* which can be obtained free of charge either from County Agricultural Organizers or direct from the N.I.A.B., Huntingdon Road, Cambridge.

Seed Dressing with Organic Mercurials

The older methods of seed treatment known in farming for many years had certain serious disadvantages, chief among them being the danger of injury to germination. With the introduction of organic mercurial seed-dressing preparations, however, the risk of damage to the grain is completely eliminated, provided that the directions are followed carefully, and it has been clearly established that seed dressing with these modern materials is of such benefit as to be accorded a regular place in the ordinary farm routine. The lavishing of manurial and cultural treatments, when plants affected with Smuts and other diseases are present in a crop, is largely wasteful.

Many farmers have made a practice of disinfecting their wheat against Bunt, previously with copper sulphate or formalin solution, but during the last ten years to an increasing extent with the modern organic mercurial preparations. The new dressings have been shown in numerous experiments to give a good protection from Leaf Stripe (*Helminthosporium*) both in oats and barley, whilst Smut of oats and covered Smut of barley are similarly controlled.

There is also a so-called " stimulating " effect produced in many cereal crops as a result of seed treatment that has been shown to be very largely due to the suppression of harmful soil organisms around the seed in the soil, so that the young seedlings grow away with a good start. Seedlings developed from disinfected seed often produce plants which tiller better and develop a more prolific root system than untreated seed. This is a definite gain because plants that establish themselves early and grow vigorously are better able to withstand the attacks of Frit Fly and other pests than those handicapped by disease and a poor rooting system.

When the organic mercurial compounds were first introduced for seed disinfection, the first to realize the benefits of such treatment were the large seed breeders. These firms, specializing in pedigree stocks of seed, naturally wished to preserve these stocks and at the same time guarantee that the farmer would reap the best possible disease-free crop. On this account they adopted the commercial dry treatment of seed before despatch from their warehouses, using the organic mercurials as the most suitable dressings for controlling seed-borne diseases, over which they would otherwise have no control. The standard they set for their seeds has had to

be vigorously maintained, and this could only be done by the specialized selection of stocks coupled with correct seed disinfection. Many merchants have installed special power machinery for the treatment of large bulks of grain, and by a simple test made possible by the inclusion of a so-called tracer dye in the principal seed dressings, it is possible for a merchant to determine whether the seed has been correctly dosed with the powder.

The practice of delivering ready-treated seed has grown rapidly during the past ten years, so that to-day there are well over three hundred firms supplying such seed on request. The service has proved of considerable value to farmers as it obviated the necessity for carrying out the additional operation on the farm. Where farmers are sowing " own-saved " seed, or wish for other reasons to carry out the dressing on the farm, this can very easily be done—preferably by rotating the grain with the dressing for about three minutes in an old churn or one of the machines marketed for the purpose, or the grain and powder may even be shovelled thoroughly on a good hard floor, being turned three or four times to ensure proper mixing. Precautions should be taken to avoid inhaling the dust.

It is safe to say that the disinfection of seed, and particularly seed oats, is a simple insurance for the crop which should no longer be neglected.

Skeps in Orchards: A New Method in Fruit Pollination

Many commercial growers who believe in cross-pollenizing their fruit blossoms have made a practice of placing box-hives singly or in groups through their fruit plantations, but during the past two years a skilled and successful bee-keeper has distributed hundreds of skeps of strong bees to fruit-growers. The skeps are placed where desired, in different parts of their farms, brought in just before plum and pear blossoms open, and taken away when the petals have fallen from cherry and apple, when the bees are no longer wanted.

The advantages of this system are (*a*) that bees in skeps cost half what they do in bar-framed hives, (*b*) that no manipulation by the fruit grower is necessary, thus saving him both time and trouble, as he only wants the bees for pollination, and the skeps are placed and removed by the contractor, and (*c*) that the skeps are easily removed from plums or pears to cherries or apples; the moving can be done much more

readily than with bar-framed hives, and the skeps can be placed in positions where they will do the most good.

The skeps are two or three times larger than the usual English skep. The entrance is on one side near the top. A plug of grass is used to stop it up in the evening when the bees have returned home, two nails being placed through the grass to make it more secure. For removal, the skep is lifted up and placed over a square of hessian, the four corners being secured in place by four long nails run into the skep; this enables the skep to be carried without fear of anyone being stung.

The skeps of bees are brought by motor lorry to the orchards and placed where needed, and when the bees are no longer required, the skeps are removed. The care of the bees is undertaken by the contractor until the following spring.

The financial arrangements are as follows:—

(*a*) The grower purchases the required number of bees outright the first year at approximately 30*s*. per skep.

(*b*) In the second year the original number of skeps is returned intact in the spring for a maintenance and service charge of 7*s*. 6*d*. per skep, which is repeated the third, fourth and fifth years.

(*c*) After the fifth year, the skeps need renewing, as straw only lasts a certain time.

The cost would thus be £3 for the five years, or an average annual cost of 12*s*. per skep.

The bee used is Dutch, which is very hardy and works vigorously in the spring.

After fruit blossoms have fallen, the bees are returned for expert care. Only one swarm is allowed to issue from each skep. After the first swarm has issued, the skeps are placed out in clover districts and *no honey is taken from them*. Swarm control is undertaken and the bees in each skep start the winter with a young queen and with all the stores they have been able to collect. Any weak or light skeps of bees are fed. All skeps are wintered under cover.

Two additional advantages of this system are that the bees can be removed while spraying or dusting, which might kill them, is proceeding, and that for the greater part of the year they are out of the way of the orchardist and his men.

The difficulty in keeping bees in districts where fruit is grown extensively, is that after fruit blossom is over there is nothing for the bees to live on. The fruit grower cannot in an average year make his bees pay through getting a crop of

honey. Pollination is the great need, and any efficient service that removes responsibility for the care of the bees is a great boon to him.

Any skep found with dead bees in, at the coming of spring, is promptly *burnt*, in order to prevent any possible outbreak of disease.

(*Cecil H. Hooper, Wye*)

Beneficial Insects

When we think of beneficial insects, our minds probably turn at once to the honey bee, which besides providing honey for human food also plays an important part in pollination, or to the silkworm, or again to the cochineal and lac insects.

There are, however, other insects which, although they produce nothing of use to man, are beneficial because they prey on the insect pests of cultivated plants. These useful insects can be roughly divided into two classes: *predators*, which kill their prey before feeding on them, and parasites, which feed on live prey. There are, however, also *hyperparasites*, which are parasitic on parasites!

It is most desirable for agriculturists and horticulturists to be able to know insect friend from insect foe, but, apart from this, the study of these beneficial insects is a fascinating pursuit. The habits of a number of the more useful and common insects of the parasitic and predatory types formed the subject of the Ministry's Bulletin No. 20, *Beneficial Insects*, first issued in 1922, and which has already run to three editions. The demand for this publication still continues and it has therefore been entirely rewritten by Dr. W. R. Thompson, a recognized authority on the subject, of the Farnham House Laboratory of the Imperial Institute of Entomology. The excellent coloured plates from the earlier editions are again included in the Bulletin, but one of them has been somewhat re-arranged.

Bulletin No. 20, *Beneficial Insects*, 4th, entirely rewritten edition. Obtainable through a bookseller or from H.M. Stationery Office. Price 9*d*. (post free 10*d*.).

Agricultural Scholarships

The Ministry invites applications for the undermentioned scholarships:—

Ten *Senior Scholarships*, tenable at Agricultural Colleges or University Departments of Agriculture, for diploma or degree courses in an agricultural subject or at Veterinary Colleges for courses in veterinary science;

Ten *Extended Junior Scholarships* (for those who have already held Junior Awards), and 120 *Junior Scholarships*, tenable at Farm Institutes or similar institutions, for courses not exceeding a year in duration, in agriculture, horticulture, dairying, or poultry husbandry.

The scholarships are open to the sons and daughters of agricultural workmen or of working bailiffs, smallholders and other rural workers whose means and method of livelihood are comparable with those of agricultural workmen, and to persons who are themselves *bona fide* workers in agriculture. The value of the awards is such that neither the recipients nor their parents are normally required to make any contribution towards the cost of the training provided. The usual method of selection is by interview, no written examination being held, but candidates must be able to satisfy the Selection Committee that they are in a position to derive educational benefit from the proposed courses of instruction and must also intend to follow an agricultural pursuit on completion of their training.

These scholarships are awarded under a scheme which has now been in operation for 17 years, and assistance has been granted to over 1,800 persons. Many former students now hold important posts connected with the agricultural industry: for example, two former farmworkers have obtained posts of Assistant County Agricultural Organizer and manager of a large farm respectively, a former dairymaid is now a lecturer at a Farm Institute, and a former poultry assistant is now employed as the manager of a large-scale poultry farm. Of those who have held scholarships under this scheme, 10 per cent. hold administrative, teaching or research appointments of an agricultural nature, while a further 18 per cent. occupy posts of a supervisory character, such as managers of farms, nurseries, dairies, and so on. Most of those who have held junior awards have returned to practical agricultural employment, a large proportion obtaining better paid and more responsible posts in the industry. It will be seen, therefore, that the scholarships afford exceptional opportunities to those who are able to obtain them and take full advantage of the training provided.

Full information concerning the scheme, forms of application and a leaflet outlining the types of career open to students who have completed courses of training, may be obtained from the Secretary of the Ministry, 10, Whitehall Place, London, S.W.1, or from the offices of County Councils. The latest date for submitting applications is April 30, 1939.

Marketing Notes

Milk Marketing Scheme, 1933: *Report of Committee of Investigation for England.* The Committee of Investigation for England have now reported on the complaint made by the Tuberculin Tested Milk Producers' Association as to the operation of the Milk Marketing Scheme, 1933, referred to in the November, 1938, issue of this JOURNAL. The Association complain that since Paragraph 65(5) of the Scheme prevented the Milk Marketing Board from reducing, before September 30, 1939, the levy payable by producer-retailers of Tuberculin Tested milk, the Board were unable to give such producers the benefit of the increased premiums payable, as from October 1, 1938, for quality milks.

The Committee met on November 4, 1938, after receiving written representations from the Board—who did not contest the complaint—and decided that, on the evidence before them, it would not be necessary for them to hear the parties.

The Committee found that proviso (*a*) to Paragraph 65(5) of the Scheme was contrary to the interests of producer-retailers of Tuberculin Tested milk, in so far as it prevented them from obtaining the benefit of the additional premiums available for the production of Tuberculin Tested milk; and that, having regard to the paramount importance, in the general interest, of encouraging the production of quality milks, the proviso was not in the public interest.

Fatstock: *Carcass Sale by Grade and Deadweight.* During the year ended December 31, 1938, a total of 13,363 cattle, 44,480 sheep and 10,545 pigs, representing a gross value of £359,748, were dealt with under the Grade and Deadweight Scheme. The figures show increases for each class of stock as compared with previous years and reflect the increasing confidence of producers in this alternative system of marketing fatstock.

The following table shows the grading of the carcasses dealt with during 1938:—

	Super	*I*	*II*	*III*	*Rejected*	*Total*
CATTLE:						
Bullocks and Heifers	44	4,473	5,218	769	114	10,618
Other Classes ..	—	797	1,210	543	195	2,745
SHEEP:						
Lambs		11,781	13,036	4,784	2,214	31,815
Other Sheep ..		7,394	3,862	995	414	12,665
PIGS:						
Pork Pigs and Sows		5,282	4,218	784	261	10,545

An interesting feature of the operation of the Scheme during the year was the increasing number of transactions arranged on a private-contract basis at the Sheffield centre. These facilities, which were provided in 1935, enable producers to sell their stock under the Scheme to particular wholesalers at prices previously arranged.

A further development was the special arrangement made in December last for the grading and weighing of sheep carcasses at the Tweedside Farmers' Co-operative Slaughterhouse at Berwick-on-Tweed, for consignment under the Scheme to Smithfield. The arrangement is on similar lines to the experimental scheme introduced earlier in the year for the marketing of sheep carcasses from Ross-shire.

National Mark Beef. During 1938, 245,253 home-killed and 108,010 Scotch-killed sides of beef were graded and marked with the National Mark, as compared with 264,049 and 101,568 sides respectively in 1937. The decrease in the quantity of home-killed National Mark beef was not due to any falling off in demand, but to a decrease in the number of eligible sides pitched on the wholesale markets. Of the total sides dealt with last year, 37.2 per cent. were graded Select, 60.0 per cent. Prime, and 2.8 per cent. Good. These figures indicate a slight upward trend in quality as compared with 1937, the number of sides qualifying for the Select grade showing an increase of 2.9 per cent.

An additional grade for Super quality beef was introduced under new regulations which came into force on December 15, 1938.

National Mark Egg Scheme. The total output of the 195 authorized packing stations which operated in the scheme during 1938 was 512 million eggs, of which 85 per cent. were packed under the National Mark. This quantity is slightly in excess of the total output in 1937, and the quantity packed under the National Mark has also risen from 424 million in 1937 to 435 million in 1938.

Livestock Industry Act: *Slaughterhouse Schemes.* The Livestock Commission have received twelve specific proposals for the establishment of central slaughterhouses. These proposals are now under consideration by the Commission with a view to the selection of three for the purposes of the experimental central slaughterhouse schemes provided for in Part V of the Livestock Industry Act.

Bacon Import Arrangements. The following are the bacon quotas (in cwt.) allotted to the principal foreign supplying countries during the period January 1 to June 30, 1939. Denmark (1,804,027), Netherlands (269,492), Poland (217,163), Sweden (133,438), Lithuania (83,725), Estonia (20,932), Finland (11,774), Latvia (19,624), U.S.S.R. (23,548), Argentina (10,465), U.S.A. (22,240). *Total*, 2,616,428.

These quotas do not include hams, for which separate allocations are now made, and the allocations are subject to amendment as regards certain countries in respect of overshipments or undershipments in previous periods.

The figures do not include supplementary allocations in January and February to offset temporary shortages from certain sources.

Bacon Supplies, 1938. The following table shows the supplies (in cwt.) of bacon (including salted pork and tinned hams) available from all sources for consumption in the United Kingdom in each month of 1938:—

Month	Great Britain			Northern Ireland Output	Net Imports †	Total Supply of Bacon to U.K. Market‡
	From Home Pigs	From Imported Pigs*	Total			
January ..	138,600	45,100	183,700	48,000	673,500	905,200
February ..	130,100	37,500	167,600	49,600	567,700	784,900
March .	162,200	47,300	209,500	59,900	657,000	926,400
April	156,800	44,200	201,000	54,500	604,100	859,600
May	174,000	45,200	219,200	61,100	661,200	941,500
June . .	163,900	44,600	208,500	62,600	580,100	851,200
July	179,700	54,600	234,300	52,800	616,100	903,200
August ..	176,600	49,300	225,900	60,900	637,300	924,100
September ..	192,500	55,400	247,900	66,600	573,600	888,100
October ..	185,300	46,700	232,000	76,100	622,300	930,400
November ..	150,200	49,400	199,600	66,000	633,700	899,300
December ..	132,300	53,000	185,300	60,800	631,200	877,300
TOTAL ..	1,942,200	572,300	2,514,500	718,900	7,457,800	10,691,200

* Including Northern Ireland pigs shipped to Great Britain.
† Imports minus re-exports. ‡ Subject to revision.

Total supplies (exclusive of the output of small unregistered curers) amounted to 10,691,200 cwt. compared with 10,632,900 cwt. in 1937.

Regulation of Imports of Processed Milks in 1938. Discussions with the representatives of the principal foreign countries of supply were held at quarterly intervals during the year, and voluntary arrangements were accordingly made for the adjustment of exports of processed milks to this country

in order that United Kingdom manufacturers should secure a satisfactory share of the home market. With the exception of a short interval during the late summer, foreign exporters and home manufacturers were subject to agreements, made between themselves, concerning the marketing of the chief descriptions of processed milks in this country.

Allocations made to foreign exporting countries for the year 1938, together with the actual imports during that year and also imports from Empire countries in 1936 to 1938 are shown in the following table:—

Source	Condensed Whole Milk	Condensed Skimmed Milk	Milk Powder	Cream
FOREIGN COUNTRIES:	cwt.	cwt.	cwt.	cwt.
Allocations	208,000	1,145,700	130,200	34,450
Imports	179,100	1,135,550	150,300	26,450
EMPIRE COUNTRIES:				
Imports, 1936 ..	115,950	82,000	173,550	42,000
Imports, 1937 ..	224,600	79,850	168,950	39,900
Imports, 1938 ..	237,250	82,000	204,750	26,550

National Mark Publicity. The Ministry will stage a representative display of National Mark produce at the Spring Horse Shows to be held at the Agricultural Hall, Islington, from February 21 to March 4.

The following is a preliminary list of Agricultural Shows where exhibits will be staged during the forthcoming summer season. A further list will be issued when definite arrangements have been made for other centres:—

DEVON COUNTY	May 16–18 ..	Axminster
BATH AND WEST	May 24–27 ..	Bridgwater
ROYAL COUNTIES	May 31—June 3	Portsmouth
THREE COUNTIES	June 6–8 ..	Worcester
ROYAL NORFOLK	June 14–15 ..	Diss
ROYAL AGRICULTURAL SOCIETY OF ENGLAND	July 4–8 ..	Windsor
GREAT YORKSHIRE	July 12–14 ..	Halifax
KENT COUNTY	July 12–14 ..	Folkestone
ROYAL WELSH	July 26–28 ..	Caernarvon
ROYAL LANCASHIRE	August 2–5 ..	Lancaster

At the above shows it is proposed, where practicable, to arrange a combined education-cum-marketing exhibit designed to illustrate the best methods of production of selected products in relation to their preparation for market. The arrangements are being made in consultation with the local Agricultural Education Authorities.

William Tompson

The footnote on p. 1129 of the February issue should have read as follows:—

Over Benty Leaser was 10½ acres. $\frac{8 \times 120 + 34}{10 \cdot 5} = 95$

PRICES OF ARTIFICIAL MANURES

Description	Average prices per ton (2,240 lb.) during week ended Feb. 15				
	Bristol	Hull	L'pool.	London	Costs per Unit¶
	£ s.	£ s.	£ s.	£ s.	s. d.
Nitrate of Soda (N. 15½%) .. *	8 0*c*	8 0*c*	8 0*c*	8 0*c*	10 4
,, ,, Granulated (N. 16%) *	8 0*c*	8 0*c*	8 0*c*	8 0*c*	10 0
Nitrate of Lime (N. 13%) .. *	7 7*e*	7 7*e*	7 7*e*	7 7*e*	11 4
Nitro chalk (N. 15½%) .. *	7 10*c*	7 10*c*	7 10*c*	7 10*c*	9 9
Sulphate of Ammonia :— Neutral (N. 20·6%) .. .. *	7 12*c*	7 12*c*	7 12*c*	7 12*c*	7 5
Calcium Cyanamide (N. 20·6%) *	7 16*d*	7 16*d*	7 16*d*	7 16*d*	7 7
Kainite (Pot. 14%) .. .. §	2 18	2 15	2 15	2 15	3 11
Potash Salts (Pot. 30%) .. §	5 4	5 1	5 0	5 1	3 5
,, ,, (Pot. 20%) .. §	3 15	3 12	3 12	3 12	3 7
Muriate of Potash (Pot. 50%) §	8 10	8 8	8 5	8 8	3 4
Sulphate ,, (Pot. 48%) §	10 2	10 0	9 17	10 0	4 2
Basic Slag (P.A. 15¾%) .. §	2 12*b*	2 5*b*	—	2 10*b*	3 2
,, ,, (P.A. 14%) .. .. §	2 8*b*	2 0*b*	2 0*b*	2 6*b*	3 3
Grd. Rock Phosphate (P.A. 26–27½%) .. .. .. §	3 5*a*	3 0*a*	2 15*a*	2 10*a*	1 10
Superphosphate (S.P.A. 16%) §	3 6*k*	—	3 2*f*	2 19*g*	3 9
,, (S.P.A 13¾%) §	—	—	2 19*f*	2 16*g*	4 1
Bone Meal (N. 3½% P.A. 20½%) §	—	7 5	6 17*h*	6 12	—
Steamed Bone Flour (N. ¾% P.A. 27½–29½%) .. .. §	4 12*i*	4 15	4 15*h*	4 10	—

Abbreviations : N. = Nitrogen : P.A. = Phosphoric Acid : S.P.A. = Soluble Phosphoric Acid : Pot. = Potash.

* Prices are for not less than 6-ton lots at purchaser's nearest railway station unless otherwise stated. Unit values are calculated on carriage-paid prices.

§ Prices are for not less than 2-ton lots, nett cash for prompt delivery, f.o.r., in town named, unless otherwise stated. Unit values are calculated on f.o.r. prices.

a Prices for 4-ton lots f.o.r. Fineness 85% through standard sieve.

b Prices for 6-ton lots. Prices at Bristol are f.o.r. Bridgwater: at Hull and Liverpool f.o.r. neighbouring works and at London f.o.r. at depots in London districts. Fineness 80% through standard sieve.

c For lots of 4 tons and under 6 tons the price is 1*s*. per ton extra, for lots of 2 tons and under 4 tons, 5*s*. per ton extra, for lots of 1 ton and under 2 tons, 10*s*. extra, and for lots of 2 cwt. and under 1 ton, 20*s*. extra.

d Delivered in 5-ton lots at purchaser's nearest railway station. For lots of 2 tons and under 5 tons the price is 5*s*. per ton extra, for lots of 1 ton and under 2 tons, 10*s*. per ton extra, and for lots of 4 cwt. and under 1 ton, 20*s*. extra.

e For lots of 4 tons and under 6 tons the price is 1*s*. per ton extra, for lots of 2 tons and under 4 tons 5*s*. per ton extra, for lots of 1 ton and under 2 tons, 7*s*. 6*d*. per ton extra, and for lots of under 1 ton, 20*s*. extra.

f Prices shown are f.o.r. Widnes.

g Prices shown are ex works London: f.o.r. southern rails 1*s*. 3*d*. extra.

h Prices shown are f.o.r. Appley Bridge.

i Price shown is f.o.r. Newport, Mon.

k Price shown is f.o.r. Avonmouth.

¶ *These are calculated by regarding a ton as comprising* 100 "*units*" (*equal parts of* 22·4 *lb.*) *so that a fertilizer, for example, with* 16 *per cent. nitrogen contains* 16 *such "units" in a ton. Then, if the price per ton of such a fertilizer be divided by the percentage figure, the deduced cost is that of a "unit" of that agent. Those in the table above are based on London prices. (For further explanation, see Advisory Leaflet, No.* 146, "*The Valuation of Artificial Manures,*" *obtainable from the Ministry, free of charge.*)

PRICES OF FEEDING STUFFS

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Wheat, British ..	4 10	0 9	4 1	72	1 1	0·58	9·6
Barley, British Feeding	6 5	0 9	5 16	71	1 8	0·89	6·2
,, Canadian No. 3 Western ..	6 12	0 9	6 3	71	1 9	0·94	6·2
,, Dutch	6 5§	0 9	5 16	71	1 8	0·89	6·2
,, Persian ..	5 17*	0 9	5 8	71	1 6	0·80	6·2
,, Russian ..	6 13	0 9	6 4	71	1 9	0·94	6·2
Oats, English, white ..	6 10	0 9	6 1	60	2 0	1·07	7·6
,, ,, black and grey	6 7	0 9	5 18	60	2 0	1·07	7·6
,, Scotch, white ..	7 3	0 9	6 14	60	2 3	1·21	7·6
,, Canadian—							
,, No. 2 Western	6 15*	0 9	6 6	60	2 1	1·12	7·6
,, No. 3 Western	6 3§	0 9	5 14	60	1 11	1·03	7·6
,, mixed feed ..	5 13	0 9	5 4	60	1 9	0·94	7·6
,, No. 1 feed ..	6 10†	0 9	6 1	60	2 0	1·07	7·6
,, No. 2 feed ..	6 10	0 9	6 1	60	2 0	1·07	7·6
Maize, American ..	6 15	0 7	6 8	78	1 8	0·89	7·6
,, Argentine ..	6 18	0 7	6 11	78	1 8	0·89	7·6
,, Benguela ..	6 8†	0 7	6 1	78	1 7	0·85	7·6
,, South African, No. 2 White Flat	7 2†	0 7	6 15	78	1 9	0·94	7·6
Beans, English, Winter	6 0§	0 18	5 2	66	1 7	0·85	19·7
Peas, English Blue ..	9 0§	0 15	8 5	69	2 5	1·29	18·1
,, Japanese ..	20 10†	0 15	19 15	69	5 9	3·08	18·1
Dari	8 0†	0 8	7 12	74	2 1	1·12	7·2
Milling Offals :-							
Bran, British ..	6 2	0 17	5 5	43	2 5	1·29	9·9
,, Broad ..	6 15	0 17	5 18	43	2 9	1·47	10·0
Middlings, fine, imported	5 15	0 14	5 1	69	1 6	0·80	12·1
Weatings‡	5 17	0 15	5 2	56	1 10	0·98	10·7
,, Superfine‡	6 5	0 14	5 11	69	1 7	0·85	12·1
Pollards, imported ..	5 7	0 15	4 12	50	1 10	0·98	11·0
Meal, barley	7 10	0 9	7 1	71	2 0	1·07	6·2
,, ,, grade II	6 17	0 9	6 8	71	1 10	0·98	6·2
,, maize	7 7	0 7	7 0	78	1 10	0·98	7·6
,, ,, South African	6 17	0 7	6 10	78	1 8	0·89	7·6
,, ,, germ ..	7 2	0 11	6 11	84	1 7	0·85	10·3
,, locust bean ..	7 10	0 6	7 4	71	2 0	1·07	3·6
,, bean .. .	9 10	0 18	8 12	66	2 7	1·38	19·7
,, fish (white) ..	15 12	2 5	13 7	59	4 6	2·41	53·0
,, Soya bean (extracted)‡ ..	8 10	1 11	6 19	64	2 2	1·16	38·3
Maize, cooked, flaked	7 17	0 7	7 10	84	1 9	0·94	9·2
,, gluten feed ..	6 17	0 13	6 4	76	1 8	0·89	19·2

Description	Price per ton	Manurial value per ton	Cost of food value per ton	Starch equiv. per 100 lb.	Price per unit starch equiv.	Price per lb. starch equiv.	Protein equiv.
	£ s.	£ s.	£ s.		s. d.	d.	%
Linseed cake—							
English, 12% oil ..	9 17	1 1	8 16	74	2 5	1·29	24·6
" 9% " ..	9 5	1 1	8 4	74	2 3	1·21	24·6
" 8% " ..	9 0	1 1	7 19	74	2 2	1·16	24·6
Cottonseed cake, English, Egyptian seed, 4½% oil ..	6 5	0 19	5 6	42	2 6	1·34	17·3
Cottonseed cake, Egyptian, 4½% oil ..	5 14	0 19	4 15	42	2 3	1·21	17·3
Cottonseed cake, decorticated, 7-8% oil	7 12†	1 10	6 2	68	1 10	0·98	34·7
Cottonseed meal, decorticated, 7-8% oil	8 5†	1 10	6 15	70	1 11	1·03	36·8
Coconut cake, 5-6% oil	7 7	0 19	6 8	77	1 8	0·89	16·4
Ground nut cake, 6-7% oil	6 15*	0 19	5 16	57	2 0	1·07	27·3
Ground nut cake, imported decorticated, 6-7% oil	7 7	1 9	5 18	73	1 7	0·85	41·3
Palm-kernel cake, 4½-5½% oil	7 5†	0 13	6 12	73	1 10	0·98	16·9
Palm-kernel cake, meal, 5½% oil	7 7†	0 13	6 14	73	1 10	0·98	16·9
Palm-kernel meal, 1-2% oil	6 15	0 13	6 2	71	1 9	0·94	16·5
Feeding treacle ..	5 0	0 8	4 12	51	1 10	0·98	2·7
Brewers' grains, dried ale	6 2	0 11	5 11	48	2 4	1·25	12·5
Brewers' grains, dried porter	5 15	0 11	5 4	48	2 2	1·16	12·5
Dried sugar-beet pulp	From £5 15*s.* to £6 5*s.* per ton, ex factory (according to factory)						

* At Bristol. § At Hull. † At Liverpool.

‡ In these instances manurial value, starch equivalent and protein equivalent are provisional.

NOTE: The prices quoted above represent the average prices at which actual wholesale transactions have taken place in London, unless otherwise stated, and refer to the price ex mill or store. The prices were current at the end of January, 1939, and are, as a rule, considerably lower than the prices at local country markets, the difference being due to carriage and dealers' commission. Buyers can, however, easily compare the relative values of the feeding stuffs on offer at their local market by the method of calculation used in these notes. Thus, if linseed cake is offered locally at £11 per ton, then since its manurial value is £1 1*s.* per ton as shown above, the cost of food value per ton is £9 19*s.* Dividing this figure by 74, the starch equivalent of linseed cake as given in the table, the cost per unit of starch equivalent is 2*s.* 8*d.* Dividing this again by 22·4, the number of pounds of starch equivalent in one unit, the cost per lb. of starch equivalent is 1·43*d.* Similar calculations will show the relative cost per lb. of starch equivalent of other feeding stuffs on the same local market. From the results of such calculations a buyer can determine which feeding stuff gives him the best value at the prices quoted on his own markets. The figures given in the table under the heading "manurial value per ton" are calculated on the basis of the following unit prices:—N., 7*s.* 7*d.*; P_2O_5 2*s.* 6*d.*; K_2O, 3*s.* 8*d.*

FARM VALUES OF FEEDING STUFFS

The prices in respect of the feeding stuffs used as bases of comparison for the purpose of this month's calculations are as follows:—

	Starch equivalent Per cent.	*Protein equivalent Per cent.*	*Per ton* £ s.
Barley (imported)	71	6·2	6 7
Maize	78	7·6	6 18
Decorticated ground-nut cake ..	73	41·3	7 7
,, cotton-seed cake ..	68	34·7	7 12

(Add 10s. per ton, in each instance, for carriage.)

The Table below is issued as a guide to farmers respecting the feeding value of their crops in relation to current market prices. (The "food values," which it is recommended should be applied by Agricultural Organizers and other advisers in connexion with advisory schemes on the rationing of dairy cows, are given in the December, 1938, issue of the Ministry's Journal, p. 965.)

FARM VALUES

Crop	Starch equivalent	Protein equivalent	Food value per ton, on farm
	Per cent.	Per cent.	£ s.
Wheat	72	9·6	7 0
Oats	60	7·6	5 16
Barley	71	6·2	6 13
Potatoes	18	0·8	1 14
Swedes	7	0·7	0 13
Mangolds	7	0·4	0 13
Beans..	66	19·7	6 17
Good meadow hay . ..	37	4·6	3 12
Good oat straw	20	0·9	1 18
Good clover hay	38	7·0	3 15
Vetch and oat silage ..	13	1·6	1 5
Barley straw..	23	0·7	2 3
Wheat straw..	13	0·1	1 4
Bean straw	23	1·7	2 4

APPOINTMENTS

COUNTY AGRICULTURAL EDUCATION STAFF: ENGLAND

Hampshire: Mr. J. T. Jones, N.D.P., has been appointed Assistant Poultry Instructor. **Shropshire:** Mr. B. J. Horsey, Dip. Hort., has been appointed Assistant Lecturer in Horticulture. **Staffordshire:** Mr. C. D. Dempster, F.R.H.S., N.D.H., has been appointed Horticultural Superintendent.

PROGRESS OF THE LAND FERTILITY SCHEME

The number of applications for contribution under the Land Fertility Scheme received from occupiers of agricultural land in the United Kingdom now exceeds 345,000. The quantities of lime and basic slag in respect of which these applications have been made are approximately 2,473,000 tons of lime and 675,000 tons of basic slag.

The Scheme came into operation on September 6, 1937. During the period September 6, 1937, to February 12, 1938, 95,000 applications for contribution were received in respect of 575,000 tons of lime and 247,000 tons of basic slag. In the corresponding period (September 4, 1938, to February 11, 1939) this season 98,000 applications have been received in respect of 814,000 tons of lime and 211,000 tons of basic slag.

FARM WORKERS' MINIMUM RATES OF WAGES

Enforcement of Minimum Rates of Wages.—During the month ending February 11, 1939, legal proceedings were taken against three employers for failure to pay the minimum rates of wages fixed by the Orders of the Agricultural Wages Board. Particulars of the cases follow :—

Committee Area	Court	Fines Imposed	Costs Allowed	Arrears of Wages ordered	No. of workers involved
		£ s. d.	£ s. d.	£ s. d.	
Yorks (W.R.)	Wetherby ..	(*a*)	—	11 12 2	1
Stafford ..	Stone ..	20 0 0	0 17 0	35 14 10	2
Cornwall ..	Tywardreath	7 10 0	1 5 0	8 13 3	1
	Totals ..	27 10 0	2 2 0	56 0 3	4

(*a*) This case had been previously dismissed by the Justices on the ground that poultry-keeping was not agriculture, but on appeal the High Court decided that the employment of the worker concerned was agriculture for the purposes of the Agricultural Wages (Regulation) Act, 1924, (see pp. 1166–7 of this JOURNAL, February, 1939) and remitted the case back to the Justices to find the offence proved.

FOOT-AND-MOUTH DISEASE

Of the Infected Areas referred to in the last issue of the JOURNAL those around Mattishall (Norfolk), Leckford (Hants) and Marlow (Bucks) have been released from restrictions.

During the period January 21 to February 17 (inclusive) nine outbreaks of the disease were confirmed. Outbreaks at Nacklington, Kent, on January 22, and Blean, Kent, on January 29, occurred in the Infected Area already existing around Barham, Kent ; an outbreak at Betchworth, Surrey, on January 29, was in the area around Peaslake, Surrey ; and the outbreaks at Bierton, Bucks, on January 24, at Padbury, Bucks, on January 26, and at Hardwick, Bucks, on February 2, were in the area around Steeple Claydon, Bucks. The outbreak at Bierton necessitated a slight extension of the Area.

The imposition of Infected Area restrictions on Areas each of approximately 15 miles radius around the Infected Places was rendered necessary by outbreaks at Conderton, Worcs, on January 21 ; at

Mattishall, Norfolk, on February 1; and at Great Chart, Kent, on February 15. The Area around Conderton has, however, now been released from restrictions, and the Areas subject to restrictions on February 17 were as follows :—

Four areas each of approximately 5 miles radius round Infected Places at Blean, Kent; Betchworth, Surrey; Mattishall, Norfolk; and Hardwick, Bucks; and one Area of approximately 15 miles radius around Great Chart, Kent.

WIRELESS TALKS, MARCH, 1939

Station and Date	*Time : p.m.*	*Speaker*	*Subject*
National:			
Mar. 2	6.20	Mr. A. Hurd and a Manager of a packing station	Egg Distribution.
,, 9	6.20	Mr. A. Hurd and a Greengrocer	The Position of the Greengrocer
,, 16	6.20	Mr. A. Hurd	The Livestock Commission
,, 23	6.20	Mr. A. Hurd	Pig Marketing
,, 30	6 20	Mr. A. Hurd	Potato Marketing.
North:			
Mar. 2	6.40	Mr. J. Strachan	North Country Farming: Fat Lambs.
,, 16	6 40	Debate between Reaseheath and Hutton Students	- -
Midland:			
Mar. 7	6.30	Professor Sir George Stapledon; Chairman, Mr. A. McVicar	Midland Farmers' Club: Grassland Improvement.
,, 14	6.50	—	Topical Talk.
West:			
Mar. 2	6.40	Mr. A. W. Ling and a Farmer from North Devon	The Raising of Fat Cattle.
,, 9	6.40	Mr. A. L. Price and a Young Farmer	Pig Keeping on the General Farm.
,, 16	6.40	Messrs. W. H. Limbrick and A. W. Ling	Odd Jobs on the Farm.
,, 23	–	Miss A. Colnett and Miss N. Lewis	Cheese Making on the General Farm.
,, —	---	Messrs. A. W. Ling, R Wightman and T. R. Ferris	Debate on Arable Land.
,, 30	- -	Mr. A W. Ling and an ex-Agricultural Scholar	Agricultural Scholarships.
Welsh:			
Mar. 3	8.00	Mr. W. T. Rowlands	Diseases of Cattle.
,, 10	6.30	Dr. Ieuan Thomas and Dr. R. P. Hobson	Insect Pests of Farm Stock.

AGRICULTURAL INDEX NUMBER

MONTHLY INDEX NUMBERS OF PRICES OF AGRICULTURAL PRODUCE
(BASE, 1927–29 = 100.)

Month	Uncorrected for Seasonal Variation 1937	1938	1939	*Corrected for Seasonal Variation 1937*	*1938*	*1939*
January	90	97	90	*85*	*90*	*84*
February	91	95		*86*	*89*	
March	90	88		*90*	*88*	
April	89	85		*92*	*89*	
May	82	82		*88*	*90*	
June .. .	81	81		*89*	*90*	
July	82	86		*88*	*94*	
August	83	81		*87*	*86*	
September . ..	87	81		*89*	*83*	
October	93	86		*89*	*82*	
November	99	89		*92*	*82*	
December	100	90		*92*	*82*	

THE SAME, TAKING ACCOUNT OF PAYMENTS UNDER THE WHEAT ACT (*a*) THE CATTLE SUBSIDY (*b*), AND GOVERNMENT PAYMENTS FOR MILK (*c*)

Month	1937	1938	1939	*1937*	*1938*	*1939*
January	92	99	95*	*86*	*93*	*89**
February . ..	93	97		*88*	*92*	
March	92	91		*92*	*91*	
April . ..	90	88		*93*	*92*	
May . ..	83	84		*90*	*92*	
June	82	83		*89*	*92*	
July .. .	83	88		*89*	*96*	
August	85	84*		*89*	*89**	
September	89	84*		*91*	*86**	
October	95	91*		*91*	*86**	
November . ..	101	94*		*94*	*86**	
December	102	94*		*94*	*86**	

(*a*) Commenced August, 1932. (*b*) Commenced September, 1934.
(*c*) Commenced April, 1934. * Provisional.

RECENT OFFICIAL PUBLICATIONS

Dairy Produce, 1938. This annual review of production and trade, just issued by the Imperial Economic Committee, notes a continued increase in the output of the chief dairy products and the maintenance of international trade in butter at the high level attained during the past two or three years. International trade in cheese has been declining for several years, although this tendency was checked to some extent during 1937, while trade in eggs, which had recovered in 1936 from a downward trend lasting for some years, has since increased further.

The increase in world butter production and trade during a number of years has been accompanied by a remarkable expansion of consumption in the United Kingdom, but more recently, with an increase in butter

prices and in the consumption of margarine, this trend appears to have been reversed. There has not been, however, either in the United Kingdom or in Empire countries overseas, any marked reduction in the total consumed, while in Germany the past two or three years have witnessed a pronounced increase.

The United Kingdom remains by far the most important market and still takes about four-fifths of the total butter entering world trade.

The United Kingdom is also the most important market for cheese. International trade in cheese has tended to decline in recent years, exports from New Zealand, the Netherlands and Canada being now much smaller than a few years ago; there was, however, during 1937 a check to this decline. The United Kingdom's imports, 90 per cent. of which are from Empire sources, have moved, on the whole, within fairly narrow limits during the past seven or eight years, declining until 1936 but thereafter recovering. The consumption of cheese has in many cases tended to increase, the United Kingdom, with an annual figure of from 8-9 lb. per head, being the only important consumer to show a persistent reduction in recent years.

International trade in eggs was declining up to 1935 but has since recovered, an expansion in shipments from most of the exporting countries of Northern Europe more than offsetting a decline in those from the Southern Hemisphere. The United Kingdom has taken the bulk of these heavier exports, but Germany also in the past two or three years has imported increasing quantities.

Prices for dairy produce and eggs have to a large extent recovered from the low levels to which they had fallen during the depression. By 1937, butter prices on the United Kingdom market were little lower, on average, than in 1931, while those for cheese showed an even more marked recovery, prices in 1937 almost attaining the 1930 level. The fall in prices was not so severe for eggs as for milk products, and although quotations for home produced eggs were by 1937 almost as high as six years earlier, those for imported eggs showed a much smaller recovery. The upward movement in butter prices continued during the greater part of 1938, although from the middle of the year the margin over the corresponding 1937 quotations was narrowing, and in the late autumn quotations fell below the previous year's level. A somewhat similar trend was recorded for cheese and egg prices, which also during 1938 exceeded, on average, the corresponding figures for 1937, although towards the end of the year they were below the comparable figures for the preceding year.

The review includes a survey of production and trade in processed milk and casein. The output of the former commodity expanded considerably in the United Kingdom after 1933, and in 1937 was more than three times as great as in the earlier year; the total manufactured in the United States, by far the largest producer, and in the Netherlands has also increased considerably. The United Kingdom remains the largest importer of processed milk, although the quantities now taken are very much smaller than a few years ago. Price 2s. 6d. (by post 2s. 8d.).

SOME ADDITIONS TO THE LIBRARY

Agriculture, General and Miscellaneous

Astor, Viscount, and Rowntree, B. S. British Agriculture. The Principles of Future Policy. A Report of an Enquiry organized by Viscount Astor and B. S. Rowntree. (xx. + 469 pp.) London: Longmans Green, 1938, 15s.

P.E.P. (Political and Economic Planning).—Report on Agricultural Research in Great Britain: A Survey of its scope, administrative structure and finance, and of the methods of making its results known to farmers with proposals for future development. (vi + 146 pp.) London: P.E.P., 1938, 8*s.* 6*d.*

Ministry of Agriculture and Fisheries. Final Report of the Departmental Committee on the Ordnance Survey. (39 pp. + 11 maps.) London: H.M. Stationery Office, 1938, 5*s.*

Batsford, H., and Fry, C.—The English Cottage. (117 pp. + 98 plates.) London: Batsford, 1938, 7*s.* 6*d.*

Hooker, Elizabeth R.—Readjustments of Agricultural Tenure in Ireland. (xii + 243 pp.) Chapel Hill: The University of North Carolina Press; London: Oxford University Press, 1938, 18*s.*

Lambert, M. R.—Biology for Senior Schools, with Instructions for Simple Practical Experiments. Book II. (218 pp.) London: MacMillan, 1938, 2*s.* 6*d.*

International Institute of Agriculture.—The Tung Oil Trees (Aleurites) and the Tung Oil Industry Throughout the World. (237 pp.) Rome, 1938, 20 *lire.*

International Labour Office.—Studies and Reports, Series K (Agriculture) No. 14:—Social Problems in Agriculture: Record of the Permanent Agricultural Committee of the I.L.O. (Geneva; 7–15 February, 1938.) (162 pp.) London: P. S. King, 1938, 4*s.*

Beck, B. F.—Bee Venom Therapy: Bee Venom, Its Nature, and Its Effect on Arthritic and Rheumatical Conditions. (xii + 238 pp.) New York and London: Appleton-Century, 1935, 18*s.*

Pitt, Frances.—Wild Animals in Britain. (viii + 120 pp. + 68 plates.) London: Batsford, 1938, 8*s.* 6*d.*

Agricultural Economics

United States.—United States, No. 2 (1938). Trade Agreement Between the United Kingdom and the United States of America. (Cmd. 5,882.) (118 pp.) London: H.M. Stationery Office, 1938 1*s.* 6*d.*

Board of Trade.—Report of Joint Committee of Enquiry into the Anglo-Argentine Meat Trade. (Cmd. 5,839.) (136 pp. + 3 maps.) London: H.M. Stationery Office, 1938, 2*s.* 6*d.*

Astor, Viscount, and Rowntree, B. S. (Editors).—Smallholdings Studies: Reports of Surveys undertaken by some Agricultural Economists. (189 pp.) London: Longmans Green, 1938, 10*s.*

Imperial Economic Committee.—Meat: A Summary of Figures of Production and Trade Relating to Beef, Mutton and Lamb, Bacon and Hams, Pork, Cattle, Sheep, Pigs and Canned Meat. (96 pp.) London: H.M. Stationery Office, 1938, 2*s.* 6*d.*

Imperial Economic Committee.—Plantation Crops: A Summary of Figures of Production and Trade Relating to Sugar, Tea, Coffee, Cocoa, Spices, Tobacco and Rubber. (113 pp.) London: H.M. Stationery Office, 1938, 2*s.* 6*d.*

Easterbrook, W. T.—Farm Credit in Canada. (260 pp.) University of Toronto Press; London: Humphrey Milford; 1938, 11*s.* 6*d.*

Eire.—Reports of Commission of Inquiry into Banking, Currency and Credit, 1938. (xxxi + 694 pp.) Dublin: The Stationery Office, 1938, 5*s.*

Agricultural Statistics

International Institute of Agriculture.—Methodological Studies in Agricultural Statistics No. 1: Vegetable and Fruit Statistics (98 pp.) Rome, 1938, 20 *lire.*

The Royal Swedish Academy of Agriculture.—Agricultural Atlas of Sweden, compiled by *O. Jonasson, E. Höijer and T. Björkman.* (176 pp.) Stockholm: Lantbrukssällskapets Tidskriftsaktiebolag, 1938.

Roumania.—L'Agriculture en Roumanie Atlas Statistique. (vi + 97 pp.) Bucuresti: Imprimeria natională, 1938.

International Institute of Agriculture.—The First World Agricultural Census. English Editions. Bulletin No. 30, Japan; Bulletin No. 33, Italy; Bulletin No. 35, Czechoslovakia; Bulletin No. 36, France; Bulletin No. 37, Germany; Bulletin No. 38, Canada; Bulletin No. 40, Mexico; Bulletin No. 41, Uruguay. Rome, 1938.

Crops

Hector, J. M.—Introduction to the Botany of Field Crops: Vol. I, Cereals (xxxiv + 478 pp.); Vol. II, Non-Cereals (479 — xxxiii pp.) Johannesburg: Central News Agency; London: Gordon and Gotch, 1938, £3 10*s.* (2 vols.).

International Institute of Agriculture.—Cotton Breeding and Seed Supply. (71 pp.) Rome, 1938, 15 *lire*

Watson, S. J.—Silage and Crop Preservation. (x + 192 pp. + 15 plates.) London: MacMillan, 1938, 7*s.* 6*d.*

Food and Nutrition

Callow, A. Barbara.—Food and Health: An Introduction to the Science of Nutrition. (viii + 168 pp.) Oxford: Clarendon Press; London: Humphrey Milford, 1938, 5*s.*

Crawford, Sir W., and Broadley, H.—The People's Food. (xiii + 336 pp.) London: W. Heinemann, 1938, 12*s.* 6*d.*

Bacharach, A. L.—Science and Nutrition. (xiv + 154 pp.) London: Watts & Co., 1938, 2*s.* 6*d.*

Department of Scientific and Industrial Research.—Food Investigation Board. Index to the Literature of Food Investigation, Vol. 10, No. 2 (September, 1938). London: H.M. Stationery Office, 1938, 4*s.* 6*d.*

Horticulture and Botany

The British Colour Council in Collaboration with the Royal Horticultural Society.—Horticultural Colour Chart. (100 pp.) London, 1938, 21*s.*

Royal Horticultural Society.—Classified List of Daffodil Names. (New Edition.) (260 pp.) London, December, 1938, 1*s.*

Quarrell, C. P.—Intensive Salad Production: Including Some Vegetables. (235 pp. + 11 plates). London: Crosby Lockwood, 1938, 10*s.* 6*d.*

Haupt, A. W.—An Introduction to Botany. (xii + 396 pp.) New York and London: McGraw-Hill, 1938, 18*s.*

American Potash Institute.—Boron as a Plant Nutrient: A Bibliography of Literature Published and Reviewed January, 1936, to June, 1938 (with index); Prepared by *Dorothy Harding* and *Catherine M. Schmidt.* (83 + xvi pp. mimeo.) Washington, 1938

Land Reclamation

Turnor, C.—Land Reclamation and Drainage in Italy. (24 pp. + 9 plates.) London: P. S. King, 1938, 1*s*. 6*d*.

Baravelli, G. C.—Land Reclamation Scheme in Italy. (39 pp. + 24 plates.) Firenze: Vallecchi Editore, 1937.

Livestock

Bodenheimer, F. S.—Problems of Animal Ecology. (vii + 183 pp.) London: Oxford University Press, 1938, 12*s*. 6*d*.

Plant Diseases

Salaman, R. N.—The Potato Virus "X." Its Strains and Reactions (from *Philos. Trans.*, Series B, 229, 559 (30 Sept., 1938) 137–217 pp. + 8 plates.)

Veterinary Science

Feldman, W. H.—Avian Tuberculosis Infections. (viii + 483 pp.) London: Baillière Tindall & Cox, 1938, 31*s*. 6*d*.)

NOTICES OF BOOKS

International Bibliography of Agricultural Economics. Vol. I, No. 1. Pp. 137. (Rome: I.A.I.; London: P. S. King & Son.)

This new quarterly publication of the International Institute of Agriculture in Rome deals with agricultural economics in all its various phases. Based on the material received by the Library of the Institute, it is compiled under the technical direction of the Librarian, Dr. S. von Frauendorfer. It covers the economic and social aspects of agriculture, such as agricultural economics, agricultural policy, settlement, credit, co-operation, insurance, marketing, prices, statistics, farm organization and management, valuation, labour, accounting, rural sociology, agricultural history and geography, legislation and education and all other agricultural problems, in so far as they are considered from the economic and social point of view. Only publications of purely technical character are excluded. All languages receive equal treatment, and titles in the less known languages are provided with a translation.

The bibliography, which is the only one which covers systematically the world literature on agricultural economics, is carefully classified by subjects. An author-index will be supplied at the end of each volume. The annual subscription, postage included, is 6*s*. 6*d*. or $1.60.

Practical Lawn Craft. By R. B. Dawson, M.Sc., F.L.S., F.R.H.S. With a foreword by Professor Sir George Stapledon, C.B.E., M.A. Pp. 300. Illus. (London: Crosby, Lockwood. 1939. Price 15*s*. net.)

Written by the Director to the Board of Green-keeping Research, St. Ives Research Station, Bingley, Yorkshire, this book will at once take its place as a standard work on the making and maintenance of good lawns. Investigations on this subject have been carried out at the St. Ives Station since its establishment ten years ago, and the information in this book is based largely on the experiments carried out there by the author and his colleagues. The book is an excellent practical guide dealing with every aspect of lawn craft. It demonstrates that the making of a good lawn is not merely a matter of mowing and rolling but is a task that calls for careful management. But if the directions in this book are followed anyone can have a lawn that he will be proud of. For the farmer who wishes to make a good lawn the chief interest of the book, and, indeed, its warning, lies in the fact that most of the conditions necessary for a good lawn are diametrically opposed to those necessary for a good pasture. The book is profusely illustrated with excellent photographs.

The Country Citizen. First Aid to the Rural Resident and the Newcomer to the Country on every description of Public Work and Voluntary Service. Written in the Country for Countrymen and Countrywomen. Second edition. Pp. 96. (Idbury: The Countryman. 1938. Price 3*s*. 6*d*.)

The sub-title of this compact little work of reference is not over-ambitious in its claims if due regard is paid to the words "First Aid." Within so small a compass it is only natural that much of the information is in the nature of pointers; but many a newcomer to the manifold, though often somewhat hidden, activities of country life will feel grateful for even a pointer. In addition, there is a lot of legal information that should save many a difference of lay opinion from developing into heated argument and consequential feud.

Sheep and Turnips. By Amelia Defries. Pp. xviii + 235. (London: Methuen. 1938. Price 7*s*. 6*d*.)

At a time when farming is so important it is appropriate that a book about Arthur Young, the great agricultural publicist of the late 18th century, should be published. Except amongst a very small and exclusive public his name has little or no significance to-day. One hundred and fifty years ago he was one of the foremost men of his time; then farming was the most important industry of the country, and was being developed very rapidly by an enthusiastic personnel. There were a number of great leaders, many of them bearing historic names, but as a writer on the subject Arthur Young was the greatest of them all. His output over fifty years amounted to some 240 volumes. This would be an extraordinary achievement for a man who spent his time exclusively in his library and his study, but Young was not of this type; he spent a great proportion of his life in the saddle or in his post-chaise travelling about the country to study the varying conditions of farming, and he acted for twenty years as Secretary to the Board of Agriculture of that time.

In the 18th century there was no accurate knowledge of the general economic condition of society. Statistics were practically pure guess-work and Young's tours and surveys of farming in the different parts of the country formed the earliest attempt at an economic survey of the industry. Twenty years after he did his individual work the Board of Agriculture undertook a series of county surveys of the whole of Great Britain, which form an unparalleled source of information regarding the farming of the day. The inspiration of these surveys undoubtedly owed a great deal to Young himself, but others, such as Sir John Sinclair, took an active part in the movement which begot them.

Of course, it is unlikely that a man with Young's literary output should be invariably consistent, and Miss Defries has pointed out that his opinion of enclosure underwent some modifications during the course of his long life. Fundamentally, however, he felt certain that enclosure was essential before the improved systems of farming could be adopted. His opinions on other matters underwent similar changes. Not the least of which was his own opinion of the works he produced in his nonage.

Like many other writers on farming, whose works have been greatly esteemed, Young himself was not successful in his farming adventures, but they formed an essential part of his education.

The book forms pleasant reading, but while it is welcome it must be regarded as work for the general public rather than for the academic, but as that was undoubtedly the intention of the authoress, little exception can be taken to it on that account.

The Mistress of Stantons Farm. By Marcus Woodward. Pp. 204. Illus. (London: Heath Cranton, Ltd. 1938. Price 7s. 6d.)

The heroine of this book, Mrs. Stacey, was born in 1812, and died in her 81st year in 1893. She married at the age of 18 and thereafter lived on Stantons Farm in the East Sussex country. Stantons was an important farm and the family, particularly in the earlier part of the period, enjoyed a substantial prosperity. It is not an easy task, to give colour and life to family records, even when the personality is as remarkable as Mrs. Stacey's evidently was, and the author, Mr. Marcus Woodward, who incidentally is the Squire's grandson, may be congratulated on his sympathetic and interesting treatment. It will be agreed that he has succeeded in reviving the atmosphere surrounding one of the larger farmhouses in the mid-Victorian period. Mrs. Stacey's recipes, of which the book contains a large number, well arranged, should be of interest to womenfolk.

Science in Africa. By E. B. Worthington, M.A., Ph.D. (London: Oxford University Press. 1938. Pp. xiii + 746. Illustrated. Price 10s. 6d.)

This book is a review of the main scientific problems related to public administration in Africa, and is issued by the African Research Survey, under the Directorship of Lord Hailey. The method of presentation is to outline the main problems arising under each of the heads of meteorology, soil science, plant industry, entomology, etc., noticing the main sub-varieties of the problem in each of the territories affected, and then detailing the methods used for solving such problems, and the institutional and other facilities available therefor, in each of the principal administrative territories. The number of the main subjects—meteorology, soil science, etc., extends to sixteen, and five of these are directly related to agriculture. Most readers will be aware that the development of Africa for the benefit of Africans or Europeans, or both, is primarily dependent on the scientific control of natural conditions and of man's exploitation of them, as contrasted with the political and economic factors which play a larger part in better developed lands; and the general effect of Dr. Worthington's work will be to strengthen one's impression that the scientific problems are of outstanding urgency. That nearly every African is said to be infected by malaria before he is three years old affords only one illustration out of hundreds.

The main branches of agriculture in Africa are shown to be subject to scientific problems of much the same importance as in the case of public health, and the treatment of them is as full as is warranted by the outstanding importance of agriculture in the African economy. Apart from the five chapters directly devoted to agriculture, much information indirectly of agricultural interest is included under other heads, such as Meteorology and Entomology. It is indeed one of the most excellent features of this book that the inter-relations of the various sciences are clearly displayed, and that justice is done to them in the arrangement of the book and method of cross-references.

For any one man to deal with the main problems of some twenty sciences may seem an ambitious undertaking, but as far as the reviewer has been able to determine from knowledge of conditions in Southern Africa, each of the sciences has been mastered to at least the full extent that a survey requires, and the relative importance of the various problems has been properly appreciated throughout. Further, the survey is anything but a dull catalogue of facts, of interest only to those concerned with African administration; the introductory sections to each chapter

make excellent summaries, calculated to be of interest to the general reader, of material which has hitherto been scattered among hundreds of monographs.

Power Farming for Crops and Stock. By D. N. McHardy. Pp. xxxviii + 208. Illus. (Reading: Philip Palmer Press. 1938. Price 8*s*. 6*d*.)

Mr. McHardy makes out a strong case for the use of more agricultural machinery as a means of reducing the cost of production and of checking the drift from the land. He contends that the introduction of the tractor has enabled farmers to maintain in cultivation land that, with horse-power only, would have gone to grass or become derelict, and he believes that the farming of the future must be based largely on the general adoption of all kinds of labour-saving machinery and devices, not only in the fields but in the farmyards and homesteads. Incidentally it is good to know that in our principal arable districts the internal combustion engine is already being adapted to a greater variety of uses than in any other part of the world. Mr. McHardy wants to see a similar development in the grassland areas, where he thinks we ought to be producing more of our animal food requirements.

In furtherance of his ideas he propounds a Power Farming Plan for operating an estate or a group of farms as a company. By this means it would be possible to introduce fresh capital into the industry to admit experienced men of small means as "executive farmers" and to reap the advantages that accrue from large scale business organization. The difference between Mr. McHardy's and other similar schemes is that while most farming companies own and operate a complete block of land consisting of numbers of holdings or "units," each in charge of a manager or bailiff and directed from the head centre, this new plan envisages an estate whereon some of the holdings might be operated by tenants in the ordinary way while others would be run by the company, each in charge of a specialist. For instance, there would be a block of land devoted to specialized cereal growing, another block to intensive dairying and the breeding and rearing of T.T. stock—on the basis of "share farming." That is to say, "an experienced breeder" would be chosen who would invest in the estate company by taking over the herd at valuation. All buying and selling would be done by the estate manager who, in respect of feeding stuffs, for example, would determine whether at any time it would be more advantageous to sell home-grown cereals and purchase imported feeding stuffs "or the reverse." It does not sound very attractive to a man with experience and capital enough to invest in 80 or 100 T.T. cows.

There would also be specialized pig and poultry holdings, the manure from which and from the specialized dairy herd would be used on adjacent market-garden and fruit holdings. Other types of holdings would be producing lower grades of milk and incidentally beef from the steers raised at the "key" dairy farm.

The book is well illustrated and contains many interesting ideas, but the "plan" will require a great deal more thinking out.

The Genetics of Garden Plants. By M. B. Crane and W. J. C. Lawrence. Pp. xxi + 287. Illus. (London: Macmillan. 1938. Price 12*s*. 6*d*.)

It is very satisfactory that a second edition of this book, first published in 1934, has been called for so soon, and the publishers are to be congratulated on issuing it at a price which brings it within the reach of students and the interested public. Little therefore need be said here of the merits of a book which has already proved its worth. It will suffice to say that it provides one of the best available surveys of the subject.

It is rather more than an introduction to the study of genetics and yet not so " advanced " as to place it beyond the scope of all but the learned few. The authors have brought together a mass of information and have presented it in a very readable and attractive form. The chapters which explain the changes which have taken place in the forms of many of the familiar flowers, fruit and vegetables, over the course of the last two or three hundred years are most interesting and informative.

Farm Gas Engines and Tractors. By F. R. Jones. Pp. xii + 486. (London: McGraw-Hill Publishing Co., Ltd. 1937. Price 21*s.*)

Published in 1932, this excellent textbook has now reached a second edition. Certain changes in form and arrangement, which readers will probably agree are advantageous, may be noted. In the first edition the book was divided into two distinct parts, (1) dealing with the fundamentals involved in the construction and operation of the simple internal combustion engine, and (2) covering the detailed construction and operation of the various types of farm tractors. In the present edition these two parts have been fused together, and the book has been further improved by a wealth of illustrations. Although no doubt intended as a textbook for students, the book deserves a wider audience. It is very clearly written, and the unitiated need not be debarred by fear of a difficult or forbidding style. The book is admirably turned out.

Corn Trade News: Golden Jubilee, 1888-1938. Pp. xxxvi + 112. Illus. (Liverpool: Northern Publishing Co. 1938. Price 7*s.* 6*d.*)

The Golden Jubilee issue of the *Corn Trade News* performs two functions. On the one hand it is a fitting memorial to the founder of the journal, the late Mr. G. J. S. Broomhall, and on the other it provides a comprehensive record of the past 50 years in the grain trade.

The history of the paper from its inception on December 11, 1888, under the title of " The Liverpool Corn Trade News " down to the present time, provides in effect the history of Mr. Broomhall, for it is clear that his life work was devoted to the collection and publication of facts and figures relating to the grain trade.

A considerable section of the book is devoted to an international survey of the trade in grain. This is comprehensive and is divided into convenient sections and periods, commencing with the European importing countries and followed by the principal individual exporting countries. The survey covers the last 50 years and is accompanied by numerous statistical tables of production, imports and exports. In the European section it is shown that the " national development of wheat production in Europe has cut down international trade in wheat and flour by some 20-30 million qrs. per annum " and discussion ensues upon the wheat self-sufficiency programme which has been attempted by certain European countries.

Other contents of the volume include a chronology of important events in the past 50 years which have had an effect upon the grain trade; an article on modern trading in futures; a calendar of seeding and harvesting in the principal producing countries, while the scientific aspects of cereal growing are dealt with under the headings of plant breeding and research.

The work should prove a very useful book of reference.

The Soil and Social Reclamation. By G. C. Watson. Pp. xv + 173. (London: P. S. King & Son, Ltd. 1938. Price 7*s.* 6*d.*)

It is difficult to appraise this little book, because its purpose is either so very obvious as scarcely to need exposition or because the " argument " is not clear. That the soil is the " mother " who feeds us is true enough,

and it may be that a useful purpose is served by these rather discursive chapters which aim at emphasizing the importance of the soil and its proper conservation for the life of humanity. Perhaps the best chapter is on soil erosion, on which the author evidently has made personal observations.

Milk Marketing Scheme: Five Years Review, 1933–1938. Pp. 59. (London: Milk Marketing Board, 1939.)

This review presents an outline of the chief features which have characterized the system of organized marketing by milk producers in England and Wales during the period 1933–1938.

The subject matter is sub-divided into ten parts, the two largest of which deal with prices and the developments, such as the milk-in-schools scheme and quality improvement measures, which have taken place. Other topics reviewed outline the trend in sales for various uses; the costs and problems of transport; the cost of administration; the scope of the Board's interest in problems of research; and the measure of assistance rendered to the industry by the Government. There are also three appendices and a number of photographs.

It is shown that total sales under the Scheme increased by 187·7 million gallons, or 21·4 per cent., between 1933 and 1938. The corresponding increase in sales for liquid consumption is given as 13·5 per cent. The magnitude of these figures and of the Board's operations in general may be gauged from the cash value of the milk sold on wholesale contract, which in 1938 amounted to £49,000,000. This turnover was handled at a cost of $\frac{1}{10}$*d*. per gallon, which represents the cost of administration on all milk passing through the Scheme.

Despite the increase in total supplies, producers' prices throughout the period have been more than maintained, for whereas in 1933 the pool price was 11·83*d*. per gallon, in 1938 it was 12·92*d*. per gallon.

As a whole, the review brings together the main results of the Scheme and indicates the general policy of the Board during the last five years.

Cottonseed Meal; Origin, History, Research. By Robert S. Curtis. Pp. xxxii + 514. (Raleigh, N. Carolina: Robert S. Curtis Publishing Co. 1938. Price not stated.)

Cottonseed meal, long used as a fertilizer in the Southern States of America, became a problematic material when first used as a feeding stuff. It was widely condemned, but the author of this book claims that what should have been condemned was not the meal but the methods of using it as a feeding stuff. Being fed too exclusively, it led to deficiency diseases which were not recognized as such but put down to poisoning. Hence, the cottonseed problem.

This work is an accumulation of all the scientific data regarding this substance which is so abundantly produced in the south and in which the North Carolina Agricultural Experiment Station has found great virtue as a feeding stuff when properly balanced in use.

The author's enthusiasm, backed as it is by the results of experiment and scientific observation spread over long periods, should do much to resolve what is apparently not a problem, but a prejudice.